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VOLUME 3, No. 3 MARCH 1951

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WORLD CROPS

Editor: Sir Harold A. Tempany, C.M.G., C.B.E., D.SC., F.R.I.C.

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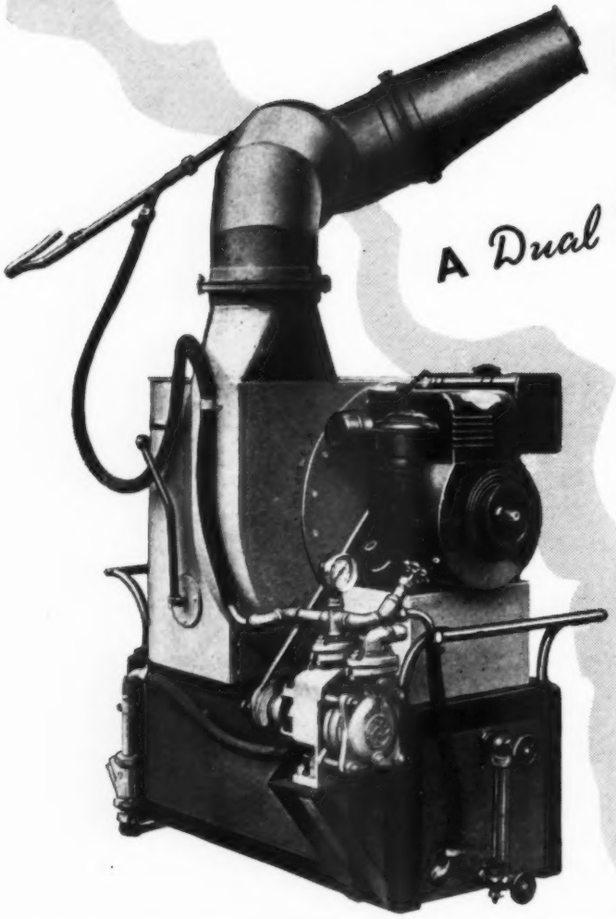

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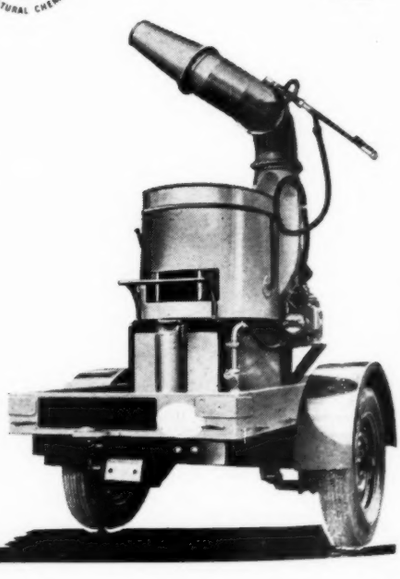

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Editorial Comment

The outlook for world agriculture

THE ever-increasing political tension throughout the world is bringing about almost kaleidoscopic changes in the outlook for food and agriculture. Rearmament must increase demands for raw materials, and it is hoped that under the urgent compulsion of circumstances some of the currency difficulties which have hampered trade may be in part reduced.

It appears, however, from the survey of world agriculture in 1950, recently issued by FAO, that in 1951 the prospects are that world food supplies are likely only to be slightly greater in quantity and nutritive value than in 1950. Moreover, gains are likely to be least in evidence in regions where improvements are most urgently needed, while taken as a whole the increases, even if they could be made freely available would hardly suffice to keep pace with the demands arising from population growth.

Of late years the outstanding feature has been the steeply rising prices of world commodities and there appears to be nothing in the present situation which warrants the hope that this will not continue. The urgent need is, of course, for still further increased production, but continually rising prices must inevitably stimulate sales resistance in consuming centres. As against this must be set the overriding urgency of demands for raw materials for military stock piling. We have seen in consequence rocketing prices for many staples: cotton, wool and rubber are cases in point.

It is easy to condemn this tendency, but we have to bear in mind that in the case of many commodities it is impossible to increase output overnight; several years must elapse before plans for increasing output can attain fruition. Especially is this so with animal products and with crops derived from permanent cultivation. It is unreasonable to expect producers to expand production without some guarantee that when their produce comes to market there will be an assurance of a reasonably satisfactory return. In such circumstances who can blame producers for pitching their demands at ever increasing levels? Such a condition of affairs is, however, most dangerous since, while conflicting views challenge one another, settlements are impossible and consumers go without. The present meat crisis in the United Kingdom is a case in point.

Nevertheless, some solution must be found if the future is to hold any prospect of security. The inflationary spiral of rising costs and prices must be checked and means found which will assure adequate safeguards to producers and consumers alike and provide the economic stability essential to prosperity.

It is by no means clear whether this can be achieved within the existing framework of world economy. It may be that a solution could be found in a system of national and international price guarantees or by a series of interlinked commodity exchange arrangements. The first thing seems to be a measure of agreement as to the need for a modified system and a willingness to discuss possible alternatives, and it is hoped that in due time the discussions and studies being undertaken by UNO and FAO may provide a basis for it.

In any event, the greatest ultimate hope of success would seem to reside in overall international arrangements taking a wide range of related commodities within their scope rather than in separate bilateral or trilateral agreements relating to single products.

The Overseas Food Corporation

THE promised White Paper on the future of the Overseas Food Corporation has now been published (Cmd. 8125). Opportunity has not yet occurred for its debate in Parliament, although we may anticipate that this will be provided in due course. As it stands the document sets out the policy which H.M. Government proposes to pursue in regard to the future of the scheme.

The document is based upon the recommendations of a Working Committee of substantially the same composition as that which earlier reported upon the Kongwa area. It recognises that the scheme as originally proposed has proved impracticable and considers that it should be regarded in future as one of large-scale experimental development to establish the economics of clearing and mechanised agriculture under tropical conditions. It proposes that it should be continued on this basis, since its abandonment after so much money and effort has been expended upon it would be a retrograde step.

With the latter view one can agree; although the scheme in its original form was based on what has proved to be a series of fantastic misconceptions, nevertheless it is essential to retrieve all that is retrievable in the hope that ultimately good will result.

We have already commented upon the proposals for the Kongwa area in our December issue, and those for the Urambo and Southern Highlands areas follow roughly similar lines. The target of a total of 600,000 acres to be brought into cultivation in all areas by 1954, set in the programme

announced in November 1949, has now been definitely abandoned. It transpires that the area contemplated in the southern region of 420,000 acres is not attainable in practice, the maximum of suitable land for development within an economic radius of Nachingwea being only 150,000 acres.

In the new proposals the conception of working units of 30,000 acres has also been abandoned as unworkable. For it is to be substituted individually worked farms varying in size from 1,000 to 5,000 acres each. Moreover, completely mechanised clearing is now regarded as impossible and for it is to be substituted mechanised clearing, supplemented by hand work wherever experience has shown the latter to be more economical.

No doubt the experience already gained in this connection is extremely valuable, costly though it may have been. An article in this issue of WORLD CROPS provides a full account of it.

The new plan

The new plan covers operations over a further period of seven years. It aims at the establishment of a pattern of agriculture based on experiment which will economically use available cleared land and point the way for future developments. It envisages annually cultivating 12,450 acres of land at Kongwa, 45,000 acres at Urambo, and the gradual extension of the cultivated area in the Southern Highlands from 7,200 acres in 1950-51 to a possible maximum of 150,000 acres in 1957.

The principal crop to be grown is still groundnuts, which are expected to account for about half the acreage cultivated, but the remainder of the cultivated area will be made up in the early stages of maize, sorghum and millet. It is proposed, however, that experimental work on soya beans and tobacco as well as cotton should also be undertaken, and if this is successful their cultivation should be started as well.

The report of the Committee upon which the proposals are based is a realistic document; it discusses in detail the various limiting factors which have to be taken into account and lays especial stress on soil conservation measures which still present many difficult problems. Experience has shown that satisfactory soil conservation is fundamental and that upon it success is in large measure dependent.

The new proposals envisage further expenditure of £8,500,000 spread over seven years. The Corporation will continue to be responsible for developments, but its responsibility will in future be to the Colonial Office and not to the Ministry of Food. It will be relieved of responsibility for the sorghum scheme in Queensland, for which new and at present unannounced arrangements will be made.

These new proposals are in our view sound and represent the only possible way to approach the problem with reasonable prospects of success. One hopes and believes that ultimately working in this way and adhering to the cautious and critical approach which characterised the deliberations of the Committee something of definite and permanent value will in due course emerge.

It is, however, disappointing that so far nothing has been said concerning the ultimate form developments will assume if these large-scale preliminary trials meet with success. Surely it is not envisaged that they will continue indefinitely as large-scale plantation enterprises worked with British taxpayers' money? There could be no justification for this, especially as it is now admitted they cannot hope to make a substantial contribution to British food supplies. The only justification for them is that ultimately they will help to enhance the productivity of Africa and so directly improve the standards of living of African peoples. Presumably this can only be secured by some form of collectivisation or co-operative working in which African peoples take an integral part. Any such developments would, however, need to be planned well ahead and must involve considerable investigation and research. If this is the ultimate aim, and it is difficult to see what other alternative exists, surely it is but common prudence to couple with these large-scale agricultural experiments parallel research on the land settlement and tenancy side, to enable a satisfactory scheme to be started when it is needed. If it is omitted it seems to us that difficulties may arise in the future similar to those which the Corporation have encountered in the past owing to lack of foresight in purely technical matters. After all, proceeding in a headlong manner can be productive of trouble in any context.

Rice supplies

WE have in these columns on many occasions commented upon the world rice situation. More perhaps than any other crop is rice the key to future developments, since it is the staple food of half the peoples of the world, while the main centres of production are concentrated within the south-east corner of Asia, where warfare and unrest are unhappily so much in evidence.

It is true that world rice production was about back to the pre-war level during 1949-50. It increased markedly in India, Siam, Malaya and the Philippines in the Far East, while record crops were harvested in many countries in the Western Hemisphere, notably in the U.S.A., Colombia and Mexico. On the other hand, hostilities in Indo-China and Korea and disturbed conditions in Burma have caused production to be far below pre-war averages in what was formerly the world's rice bowl, while in China itself a bad season led to partial crop failure in that country.

Moreover, prices for rice have risen disproportionately compared with other cereals and it is far more expensive than wheat; this combined with lack of exchange has limited possibilities of importing rice into Eastern countries. It is true that imports of wheat and coarse grains have increased considerably and this has compensated to some extent for the decline in available rice supplies, but it is doubtful whether in the forseeable future Eastern populations will ever regard wheat as an entirely acceptable substitute.

In these circumstances it is hardly surprising that countries in the Far Eastern area are aiming at expanding their domestic rice production as rapidly as possible. The Colombo Plan, upon which we commented in our last issue, lays primary emphasis upon measures designed to assist in this. Already India has drastically reduced her import demands and considerably extended rice cultivation; in Pakistan there has been a considerable shift from jute cultivation to rice in Eastern Bengal; in Siam rice cultivation has extended, but large-scale expansion is, as elsewhere, largely dependent on improved water control and better transport facilities.

In any event, if the needs of the rapidly growing population are to be met, and especially if living standards are to be raised, rice production in these regions must be raised well above pre-war levels and yields considerably increased, since it is only by these means that prices can be brought down to a parity with other cereals. As it is now, in most Eastern consuming countries heavy subsidisation and rigid rationing of rice supplies are necessary.

Above all, rehabilitation of the rice industry and increased production depends on the cessation of military operations and the restoration of settled government and law and order in these regions.

Natural versus synthetic insecticides

THE recent rapid development of the synthetic organic insecticides, notably chlorinated hydrocarbons and organo-phosphorus derivatives, has tended to deflect attention to some extent from the insecticides of vegetable origin. Pyrethrum, it is true, still continues to hold the field on account of its unrivalled ' knock down ' effect, but Derris, which at the outset of the war was regarded as a vital material, suffered a temporary eclipse when DDT came on the scene as an emergency replacement for it when Derris supplies were cut off by the Japanese invasion of Malaya and Indonesia.

For a time the view was widely held that Derris and other rotenone-containing insecticides had had their day, but this is slowly receding and the demand for these materials is once more steadily on the up-grade, the view being increasingly that for some purposes rotenone has advantages.

Nevertheless, there is no doubt that the activities of organic chemists and entomologists are still mainly concentrated upon synthetics and the possibilities of finding other valuable insecticidal substances in plants are to an extent neglected.

A recent paper by Mr. Shin Foon Chin in the *Journal of Food and Agriculture* discusses this aspect and gives data of research carried out by himself, in the course of which he reports the results of testing nine species of plants collected in South China against 40 species of insects.

He asserts his belief that many organic compounds of great insecticidal value await discovery in the vegetable kingdom and that studies of the chemistry and biological activity of plant materials may lead to the discovery of new compounds for insect control. He considers that it would be very much worth while to undertake systematic investigations.

We feel that there is considerable substance in this plea. The results which he cites for the nine plants he himself examined appear to bear the contention out.

It is obvious that the momentum which organic research has gained in regard to the synthesis of new insecticides will continue to grow, and further progress on even more spectacular lines seems not improbable; but this is no reason for neglecting research in this parallel and, we believe, potentially fertile field.

Raindrop erosion

IT is an obvious remark to state that erosion dangers are greatest where rainfall is heavy and where it is liable to come in the shape of heavy falls. It is only within recent years, however, that the importance of the direct impact of raindrops on the soil surface as an erosive factor has become appreciated.

The matter was called attention to by W. D. Ellison in the U.S.A. some six years ago, and since then he and other workers have published a number of papers on the subject.

It is obvious that falling raindrops possess considerable kinetic energy and that when they strike the soil this is dissipated. It has been calculated, for example, that 2 in. of heavy rain in which the drops fall at the rate of 20 miles per hour dissipate when they strike the ground 6 million ft. lb. of work per acre, or sufficient to raise the top 6 in. of soil 3 ft. in the air.

The immediate effect of this is to break up soil aggregates and clods and so to accelerate erosion, for the loosened material becomes washed away and, moreover, tends to seal up the channels and cracks in the soil surface thereby lowering or removing the ability of the soil to absorb water and increasing the erosive losses by surface run off.

This type of erosion is often termed splash erosion. Recently Woodburn has shown that the

amount of soil dissipated thereby can be expressed by an equation $S=KE^n$ where S is the amount of soil splashed, E is the energy of the raindrops, depending on their size, speed and frequency, and K and n are constants depending on the soil.

A further effect of raindrop splash which has recently appeared is that when run-off is moving as a broad sheet the impact of raindrops starts turbulences in the water which greatly increase the amount of suspended soil and therefore erosion losses. On page 122 we reproduce two photographs which illustrate the effect of splash erosion.

Argentine ants

WE have in an earlier number commented upon the multifarious activities of ants and on the fact that, while some species are at times beneficial, others are decidedly the reverse. Among the latter must certainly be numbered that known as the Argentine Ant (*Iridomyrex humilis*) which, in addition to being an extremely annoying and serious household and agricultural pest, is one of the most persistent and habitual travellers to all parts of the globe.

It is believed to be a native of Argentina and other parts of South America, but it was not till 1888, when it was introduced into New Orleans, that it began to leave its native haunts; since then it has spread and is still spreading throughout the warmer parts of the U.S.A. It has also spread to other parts of the world. Thus it is a serious pest in the Mediterranean region and in South Africa; it is a greenhouse pest in England, Germany and Belgium; in 1941 it appeared in Hawaii, despite rigid quarantine precautions, and slightly prior to that appeared in a suburb of Melbourne in Australia. In 1941 it was recorded in Western Australia and is now a serious pest there, while quite recently it has made its appearance in New South Wales, where it is naturally regarded with considerable alarm.

The ants themselves are each about one-tenth to one-eighth of an inch long, and travel well-defined lines to and from their nests, which are made below the soil surface or under floors, paving and similar conditions. They are unable to sting or bite effectively, and this is probably a merciful dispensation of providence, for they are omnivorous and all-pervading in premises that become infected, penetrating even into beds and refrigerators. But it is in their agricultural aspect that they are most damaging, particularly in orchards, for they are especially active in protecting and tending sap-sucking insects such as scale insects, aphids and mealy bugs, of which the natural predators are much less in evidence in localities where the ants are abundant. They may damage flowers and seeds in seed beds, while they are a menace to apiarists. Their natural spread is slow and it is mainly by artificial means that they have become widespread throughout the world, *e.g.* by transport in seed boxes, living plant material, plant debris and the like, and accordingly strict quarantine measures are essential if further spread is to be arrested.

In their treatment the chlorinated hydrocarbon insecticides have been shown to be effective and DDT and BHC have given good results, while experiments in various countries have shown that Chlordane is very specific against them. It is to be hoped that the application of these remedies may eventually effectively control them wherever they have established themselves, and that the exercise of more rigid quarantine measures may prevent their entry into countries where they have not so far made their appearance.

Parthenocarpy and pips

TO how many of us, who have passed the threshold of middle age or are entering upon the sere and yellow, is not the habit of many luscious fruits of producing large quantities of small seeds in their succulent matrices a source of sadness and regret? With what envious eyes do we not view the care-free abandon with which the younger generation—whom time has not yet compelled to replace the masticatory aids provided by nature with the ingenious artificial substitutes of the dentist—enjoy the delights of figs, raspberries, loganberries, blackberries and the like, well knowing that if we attempt to emulate them there lies in wait for us a nemesis of discomfort, temporary it is true and easily remedied given the necessary facilities, but oft-times agonising while it endures?

For these, some recent work by J. C. Crane and R. Blondean on inducing parthenocarpy in figs by the use of plant hormones holds out a message of hope. They found that by spraying immature fruit of Calmyra figs with 3-indolylacetic acid in oil emulsions containing 1,500 to 2,760 parts per million of the active agent, it was possible to produce satisfactory crops of seedless fruit. Let us hope that in due time the pipless fig will become an article of commerce. Let us also hope that eventually it may be found possible to apply similar methods to other multi-seeded fruit and that we may look forward to pipless raspberries, blackberries or gooseberries.

THIS MONTH'S COVER

The Bushy Park-Glenora area of Tasmania, only a few square miles in extent, is the main hop-growing area of Australia. This scene, looking along the Derwent River towards Bushy Park, might well be in Kent. On the right bank, near the bridge, may be seen the hop fields and kilns of Kentdale Estate.

(Photo: Australian News and Information Bureau)

Fig. 7. A final heavy disc ploughing is carried out before the land is considered fit for agricultural cultivation.

Mechanised Land Clearing

A Survey of Four Years' Experience in Tanganyika

J. MacBRIDE
Pauling and Company Ltd.

J. E. CAPELL and W. CATHIE
Earth Moving and Construction Company Ltd.

D. R. KAUFMANN and A. H. BUNTING
Overseas Food Corporation

Prominent among the problems which the Overseas Food Corporation had to face in their operations in Tanganyika was that of mechanically clearing large areas of scrub forest and bush. New techniques and new or modified machinery and implements had to be devised. The following article by members of the technical staffs responsible for these operations, summarises the experience of the past four years and describes the methods adopted and their limitations.

LAND clearing by hand has at one time or another been extensively practised by African and European agriculturists over vast areas of East Africa. The principal means employed are ring barking, felling and burning.

Mechanical techniques were used in East Africa before the second world war in the clearing of old sisal land and in controlling the invasion of grassland by thicket. In sisal clearing, level root-free seed beds were not called for and operational costs for clearing, piling and ploughing were of the order of £2 per acre; one tractor hour costing 10s. Caterpillar RD6 and RD7 tractors with La Plante Choate tiltdozers were used, stumping, where necessary, being done by hand. The areas involved were at most a few thousand acres in any one instance.

In 1943 the Kenya Government employed a contractor to clear 3,000 acres of forest and bush for food production. Teams of five caterpillar D8 tractors with Le Tourneau bulldozers and Le Tourneau H3 rooters cleared and ripped the land and roots were collected by hand. Operational costs (including ploughing with 8-ft. Roman disc ploughs) were £8 per acre, one tractor hour costing 35s. Later work in 1946-47 with larger teams and less experienced staff was carried out at £12 10s. per acre, with a cost per tractor hour of 50s.

Clearing operations for the Groundnuts Scheme began in April 1947 in the Kongwa area of the Central Province of Tanganyika. Operations there were completed in 1949 at a total acreage of 81,000, of which 63,000 had been cleared from thicket. In August 1947 work began at Urambo, in the Tabora district of the Western Province of Tanganyika, and development there was suspended in 1950 at a total of 65,000 acres, all cleared from woodland. In January 1948 the first small clearings were made in the Lindi district of the Southern Province of Tanganyika, near the village of Ruponda, the headquarters being subsequently moved to Nachingwea. For the crop season of 1950-51 about 6,000 acres will probably be prepared for agriculture, all from woodland.

This paper presents a general account of experience at Kongwa and Urambo. The main vegetation types of Urambo and the Nachingwea-Ruponda area are broadly similar, but the difficult development conditions of the Southern Province have made the results achieved so far in that region unrepresentative.

No figures of operational costs are included, since the very difficult development conditions make any estimates unrealistic.

Description of the regions

(a) Kongwa region. The Kongwa region lies in the Central Province of Tanganyika, 200 miles from Dar es Salaam, at an elevation of 3,000 ft. above sea level. This region is the driest of the three, with an annual average rainfall of about 20 in. only. Although the rains are confined to a single season of the year (December to April), they are somewhat unreliable and uneven in their distribution. The prospects of the region may depend very largely on the accumulation of subsoil moisture by water conservation techniques.

The soils are derived mainly from hornblende-gneiss, which at Kongwa normally yields a red soil whose mechanical composition would, in a temperate region, justify its description as a medium to light red loam. On the tops of the gentle ridges there occur pinkish, buff, yellow, grey or almost white soils (the upland pallid type), very sandy in mechanical composition and probably derived at least in part from granitic gneisses. All these soils compact on drying, unless broken up before drying is complete. This property is of great importance in clearing.

A separate class of soils occupies the drainage depressions of the gently undulating terrain, or the extensive beds of former shallow lakes. These soils, which are yellow, grey, chocolate or black in colour, and have varying proportions of clay, do not compact seriously, but as they originally carried little woody vegetation they do not require further consideration here.

The vegetation of the red and upland pallid soils is for the most part a dense impenetrable thicket up to 15 ft. high of species of *Commiphora*, with some baobabs (*Adansonia digitata*), umbrella acacias (*Acacia tortilis*) and species of *Grewia*, *Lannea* and many other genera (see Hornby and Hornby, 1942). It is known colloquially as rhino bush or *mchaka*. The thicket itself is free of tsetse fly, but wetter spots or old clearings on fan slopes may carry open umbrella acacia communities which are being invaded by tsetse in other parts of Central Tanganyika.

(b) Urambo region. The Urambo area lies about 500 miles from the sea in the Western Province of Tanganyika, at an altitude of 3,500 ft. The average rainfall is about 35 in. annually, falling between late November and the end of April. The rain is well distributed and appears no more unreliable than that of other parts of the interior plateau of East and Central Africa.

The soils are all derived from granitic gneiss of the basement complex. The crests of the ridges and the upper parts of the gentle slopes are occupied by a red loam which readily compacts during drying if it is not worked. The soil of the lower parts of the slopes, running into the drainage lines, is a grey non-compacting sandy soil with a heavier subsoil. The drainage lines are filled with a range of sands, silts and clays, but as they have not been cleared they do not concern us here.

The vegetation at Urambo is a tall, open woodland, the well-known *miombo* or *Brachystegia-Isoberlinia* dry forest, which in one form or another occupies millions of square miles of tropical Africa in the 30- to 50-in. rainfall areas. The trees are up to 60 ft. high, and there are usually about 150 stems of all sizes to the acre. The majority are below 12 in. diameter. There is no consistent woody under-story, and at Urambo grass is not very strongly developed in the woodland, being mostly below 4 ft. in height. The shading is somewhat dappled, and not at all dense, so that in the dry season, particularly after the annual grass fires, one can drive freely in the forest.

Clearing methods

(a) Preparation. Following preliminary reconnaissance, boundary traces were cut at Kongwa, using caterpillar D8 tractors fitted with bulldozer blades, mostly of Le Tourneau type. Trials with brushcutters for this work had some success, but brushcutters had no other applications in clearing and it was not considered economical to purchase them in quantity for one operation only.

Next, the area to be cleared was subdivided by traces cut on compass bearings at intervals of one mile and at right angles to each other. The grid of traces enabled general levels to be surveyed. All land with a slope over 5% (5 ft. fall in 100 ft. superficial distance) was rejected as being too steep for economical soil conservation under local conditions. Drainage lines and local depressions were also rejected. For the clearing operations the square-mile blocks were divided into sixths by additional temporary traces. The mile traces, graded into earth roads, remain permanently as access roads to the fields. Strips 100 ft. wide on either side of the traces are not cultivated, being allowed to regenerate in grass in order to provide for discharge of run-off water from the roads.

The methods used at Urambo differ in important respects from those employed at Kongwa. Owing to the higher rainfall, erosion risks on fields and roads are much greater at Urambo, and the square layout used at Kongwa is not applicable. Clearing has had to be related closely to topography. The road systems run along the ridges, with 100-ft. belts of trees on either side of the carriageways. The drainage lines are left uncleared, so that the cleared land falls away from the wooded verge of the ridge road to the standing woodland lower down.

Topographic survey before clearing (which was impossible in the dense Kongwa district) has thus been of the highest importance at Urambo, and clearing has been closely controlled and guided by the results. Air photographs prepared by the Colonial Surveys Organisation have been of great assistance. The relatively uniform soil pattern has not called for detailed soil survey of the type which has been carried out in the Southern Province, but soils have been mapped in general outline on the topographic maps.

(b) Felling. Felling was initially performed both at Kongwa and Urambo by teams of caterpillar D8 tractors with bulldozer blades, which moved clockwise round the clearing blocks of $\frac{1}{6}$ square mile, pushing over the trees and heavier scrub. This method was replaced in both regions in 1949 by chain felling, first developed, so far as the Groundnuts Scheme is concerned, at Urambo. In it the ends of a length of anchor chain are attached to two tractors, which then move on a parallel course through the bush. The loop of chain rides up the trees as they bend under the pull of the chain. As its height increases the leverage increases until (in wet soil) the tree is pulled over and the stump snaps below ground. In dry soil the trunks are merely broken off at or above soil level. At Urambo some of the trees are sufficiently large to resist this treatment and so a third tractor, equipped with tree-dozing equipment, was put into the team to run behind the loop of chain and assist with the refractory stems. This was not generally necessary at Kongwa. At Urambo 150 ft. and at Kongwa 120 ft. of chain (9 in. by $1\frac{1}{4}$ in.) were used.

Chain felling is greatly superior to winching, which has been tested at Urambo and in the Southern Province. Fig. 1 shows diagrammatically the disposition of the tractors in chain felling, and Figs. 2 and 3 show the method in operation.

Soil conservation

The soil conservation system at Kongwa was originally based on the necessity of conserving rainfall and was aimed at the complete prevention of run-off. The anti-erosion system was therefore set out on a true contour wherever possible, rather than on a falling line of variable grade discharging into a drainage line, as is standard

Figs. 2 and 3. Bush flattening by the chain system at Urambo in the Western Province of Tanganyika. Crawler tractors towing behind them a length of heavy anchor chain travel through the bush side by side pulling down a strip of trees behind them, all of which fall roughly in the same direction. Following them is a third tractor fitted with a tree dozer arm, used to pushed down any obstacles which do not yield to the combined pull of the two leading tractors.

practice in wetter regions. The contours were surveyed and marked out after felling, the work being done by a pair of bulldozers, on one of which a simple level was mounted. These cleared a pathway through the felling debris. A team of African surveyors followed on foot and pegged out the true contour. The earth pushed on to these lines during piling (see below) formed a rough and ready conservation system.

It was originally intended to use a vertical contour interval of 3 ft., but pressure of time and the difficulty of working the narrow strips which would often have been produced led to the initial lines being set out at 9-ft. vertical intervals.

The conservation system thus produced at Kongwa has since been shown to require modification, since it did not take account of the less conspicuous drainage lines which may carry a considerable discharge after heavy storms. In some areas the level contours have been replaced by variable grade contours discharging into the natural drainage system, in which the bush was, for the most part, left standing as an additional measure of protection against erosion.

The soil conservation system at Urambo was put in after clearing had been completed. It is based on variable grade banks discharging into natural drainage lines or, where these do not occur sufficiently frequently, into artificial discharge areas, the so-called water meadows. The banks are surveyed and put in (with mechanical graders) after clearing is completed. The vertical interval used varies from $2\frac{1}{2}$ to $4\frac{1}{2}$ ft.

Piling and burning

The next clearing operation was the removal and burning of the felling debris. At Kongwa this was pushed into so-called windrows on the contour lines marked out as described above. Bulldozers were principally used in this operation. They pushed up a considerable bank of soil with the debris and these rough banks have been the mainstay of the conservation works at Kongwa. Whenever possible, the debris was burnt over before windrowing; this greatly simplified piling. All debris in the windrows was finally burnt (Fig. 4).

At Urambo the piling system was based on the fact that in chain felling the stems all fall in the same direction, in rows roughly parallel to the line of movement. This greatly facilitates piling, which consists of combining three adjacent rows into one by pushing the two outer ones on to the centre one. The breaking of many of the branches by the chain during felling also simplifies the piling.

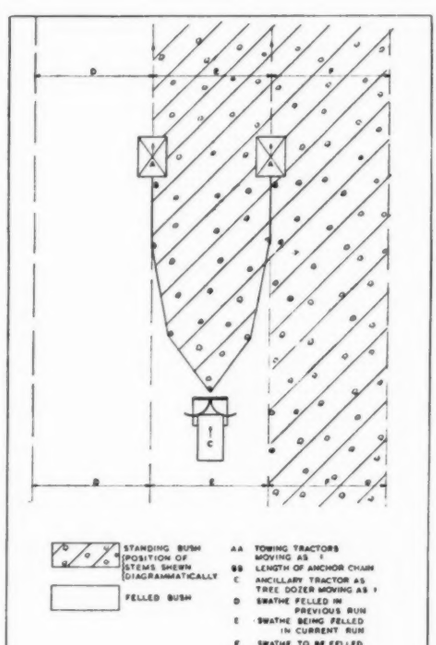
STANDING BUSH (POSITION OF STEMS SHEWN DIAGRAMMATICALLY
FELLED BUSH
AA TOWING TRACTORS MOVING AS ↑
BB LENGTH OF ANCHOR CHAIN
C ANCILLARY TRACTOR AS TREE DOZER MOVING AS ↑
D SWATHE FELLED IN PREVIOUS RUN
E SWATHE BEING FELLED IN CURRENT RUN
F SWATHE TO BE FELLED IN SUCCEEDING RUN

Figure 1. Diagrammatic plan of chain felling operation

The piles thus produced are burnt and the unburnt material is again pushed together in ' second piling ' for a further burn. Any debris still remaining is pushed off the field.

Rooting and stumping

This phase of the operation was, and still is, the most unsatisfactory of all. Initially the roots were torn with Le Tourneau three-tined road rippers penetrating as much as 18 in. and drawn by D8 caterpillar tractors. These implements were soon clogged with festoons of roots and had frequently to be lifted and cleared. Subsequently various methods of attaching a horizontal cutter bar to the tines were tried, in order to effect a more thorough extraction of roots. One of the resulting implements, the Gladwell rooter (named after the late A. L. Gladwell, of Nairobi, who played a considerable part in the development of these clearing methods), has been widely used in all three regions, but it suffers from the common defects of all the equipment so far used. It clogs and requires frequent clearing and is not designed to provide a vertical as well as a horizontal cut (Fig. 5).

The Davis plough (a heavy-duty disc plough) was extensively used at Kongwa, and later at Urambo, but as it merely cut the roots without extracting them it left considerable obstacles to the operation of agricultural implements.

No rooting implement yet employed is capable of extracting stumps. Where felling is done in the wet season, particularly by the chain method, most of the trees are

pulled out with their stumps and larger roots. In many areas at Kongwa it was necessary to fell in the dry season, with the result that anything up to 100 stumps per acre remained. The extraction of these by mechanical means (with angledozers or Fleco type stumpers) is costly and involves great disturbance of soil and subsoil, and is, in fact, best performed by hand if the necessary labour is available.

Raking and levelling

The root and stump debris had next to be removed to the windrows. Various types of forward-mounted rake were tried, but the greater part of the work was done with Blaw-Knox towed rakes (Fig. 6). The raking was usually followed by hand collection of these roots which still remained.

This sequence of clearing operations leaves the ground in a very uneven state. The raking has some levelling effect, but at Kongwa the final levelling was done with an implement made of lengths of railway track and fitted with heavy rigid tines, rather like an enormous peg-tooth harrow. At Urambo the rakes used for removal of root debris have been found to level the surface sufficiently well to permit agricultural operations to commence (Fig. 7).

Phasing of operations

A favourable phasing of operations was never possible in practice at Kongwa, owing to the urgency with which the work was pressed forward. Ideally, felling should occur in the wet season, when the soils and subsoils are moist and allow the trees to be pulled or pushed over with their roots still attached. In dry compacted soil the roots are more firmly held and the stems tend to break, leaving many stumps behind. Contouring, piling and burning are suitable operations for the dry season, but rooting is essentially wet season work. Rooting in dry compacted soil increases enormously the amount of soil disturbance and the abrasion of parts in contact with the soil. In extremely wet conditions, of course, rooting (and felling to some extent) may greatly damage the soil by churning and puddling the mud. Stumping, raking and levelling are dry season operations. Thus the full cycle should ideally occupy at least two years in regions with one wet and one dry season each year. Some approach to such a system of operations has been possible at Urambo. There, however, the considerably higher rainfall leads to wet soil and subsoil conditions for longer periods, when the movement of heavy tractors or the passage of implements through the soil may do serious damage. In general, a far more sensitive control of operations in relation to climatic and soil conditions is called for at Urambo.

Table 1 shows the equipment used and the average time taken in operations at Kongwa in 1949, the last season of clearing there. Table 2 sets out the equipment used in 1950 at Urambo and the average time of the various operations in the three years 1948-50. It must be realised that the figures given refer to operations under difficult development conditions and that they are subject to some variation on different soil and vegetation types within the main communities.

Operational problems

Many major operational problems of mechanical clearing still remain unsolved at the present time. The attack on these is being vigorously pushed forward in the Corporation's development of the Southern Province, where clearing reached a significant scale in the 1949-50 wet season. The more important questions are discussed below.

(a) Tractor types. At Kongwa and Urambo the greater part of the clearing was done with American tractors made by Caterpillar, Allis Chalmers and International. In 1948, trials of the British Shervick tractor began, and this machine is in large-scale use in the Southern Province. A number of weaknesses were soon found in the Shervick and many modifications have been shown to be necessary. Inevitably adverse comparisons have been

TABLE 1

EQUIPMENT USED AND TIME OCCUPIED (1949 SEASON) IN CERTAIN CLEARING OPERATIONS, KONGWA

	Operation				
	Felling	*Windrowing*	*Stumping*	*Ploughing and Root Cutting*	*Raking*
I. *Equipment used :*					
Caterpillar D8	*	*	*	*	*
Caterpillar D7	*[1]	*		*[3]	*
Allis-Chalmers HD14	*[1]	*		*	*
Allis-Chalmers HD10 ..		*		*	*
International TD18		*	*[2]		*
Bulldozer	*	*	*		
Angledozer	*	*			
Treedozer	*				
Ripper			*	*	
Disc Plough				*	
Drawn Rake					*
Forward Rake					*
Rootcutter (Blaw Knox) ..				*	
,, (Gladwell) ..			*	*	
Stumper			*		
Anchor chain	*				
Brush rake	*		*		
II. Time occupied, hours/acre, 1949	0.50	1.73	0.77	0.97	0.36

[1]On solo felling only (not chain). [2]With angle dozer only. [3]After ripping only.

TABLE 2

EQUIPMENT USED AND TIME OCCUPIED IN CERTAIN CLEARING OPERATIONS, URAMBO

	Operation						
	Felling	*1st Piling*	*2nd Piling*	*Stumping*	*Root-cutting*	*Raking*	*Levelling*
I. Equipment used (1950 *season) :*							
Caterpillar D8	*			*	*	*	*
Caterpillar D7		*	*			*	*
Bulldozer ..	*	*	*	*			
Angledozer		*	*	*			
Treedozer ..	*						
Ripper ..					*		
Drawn Rake						*	*
Forward Rake		*	*				
Rootcutter (Gladwell)					*		
Stumper ..				*			
Anchor Chain	*						
Brush Rake		*	*				
II. Time occupied, hours/acre :							
1948 ..	1.28[1]	2.70	[5]	1.92	1.49	1.59	0.73[2]
1949 ..	0.94[3]	1.52	[5]	1.55	0.89	0.64	0.96[4]
1950 ..	0.74[2]	1.40	0.47	0.53	1.41	0.61	0.48

[1]Pushing. [2]Chain felling. [3]With levellers made of timber. [4]With light rakes.
[5] Included in first piling.

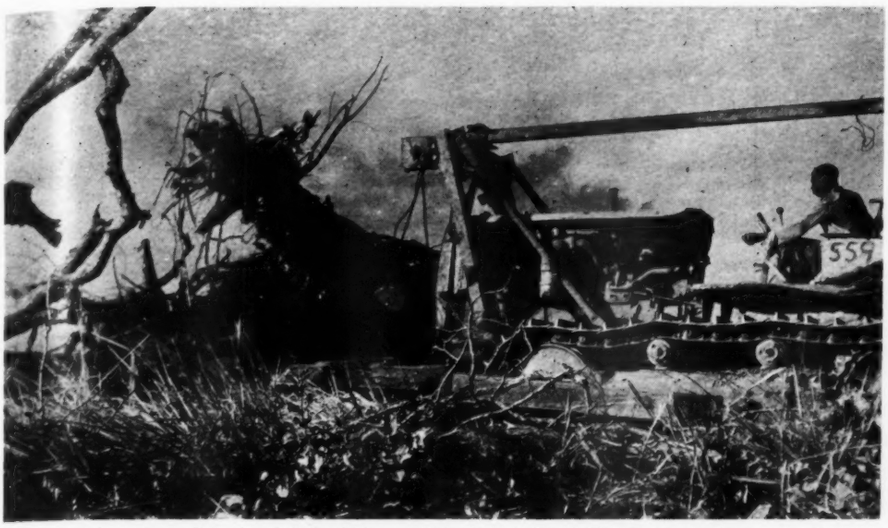

Fig. 4. **Tractors fitted with bulldozer blades 'pile' the flattened rows of trees and branches which are then burnt. Any unburnt material is again piled and burnt and then any remaining trash is pushed to the side of the field**

Fig. 5. **'Gladwell' Rootcutter. The design consists essentially of a horizontal blade which can be raised or lowered**

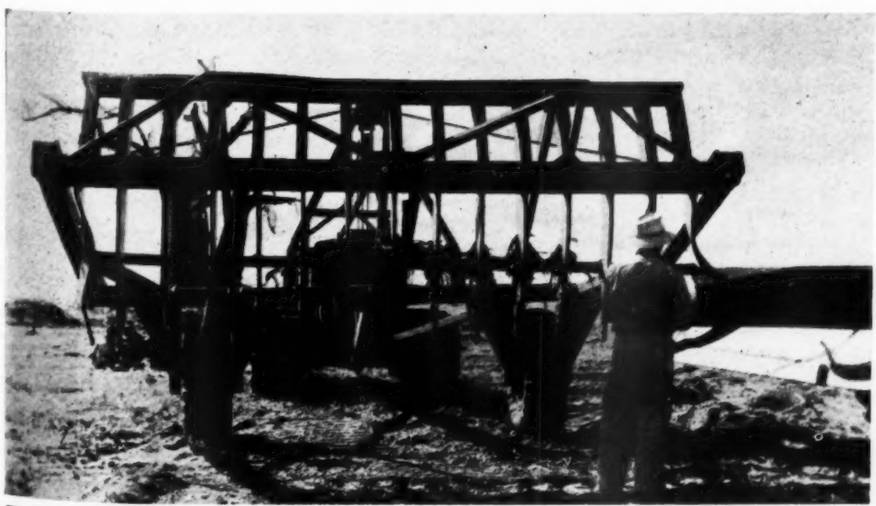

Fig. 6. **Blaw-Knox root rake. Note the twisted tine on the right, giving some idea of the damage caused by underground tree-stumps**

drawn between this new, and as yet not fully developed, tractor and the American types, which embody the results of many years of experience of operation and manufacture.

(b) Rooters. There has been a long history of research into the design of an improved rooter. Theoretically, a rooting machine should combine a vertical and a horizontal cut. Combinations of heavy shares with large discs have been tested, but in most cases, even where the principles have appeared to be correct, the engineering design has been shown to require considerable improvement.

Much study has been devoted to methods of construction aimed at achieving constant draft by keeping the blade of a Gladwell type rooter horizontal in the ground. A prototype rooter embodying this principle has been constructed and is under test and modification.

(c) Other equipment. Perhaps the most serious difficulty in the design of all types of clearing equipment is involved in making them strong enough for continuous operation, under very hard conditions, without unduly increasing their weight. In most cases the equipment used in mechanical clearing was originally designed for other purposes, such as earth moving and road construction. The mechanical tasks involved in clearing are often very different from those for which the equipment is intended; and even where the tasks are broadly similar the stresses involved may be different. These differences cause breakages and necessitate much attention to maintenance and modification.

(d) Maintenance. One of the biggest difficulties has been in the maintenance and repair of the heavy equipment. It has often been necessary to attempt large-scale clearing without adequate workshops for major repairs and with improvised routine maintenance arrangements. Such efforts have nearly always failed and have always been extremely expensive. It was difficult at the outset to specify the organisation, methods and equipment which would be needed until the conditions and hazards of operation were known; and undoubtedly the Tanganyika experience has produced most valuable information on these vital questions.

Conclusions

Clearing has now ceased at Kongwa and Urambo, and the experience gained in those regions is now being applied in the third region of the Corporation's development in the Southern Province.

It is now clear that we know in some detail how to clear both thicket and woodland but that there is much to be done

before either the equipment, or the organisation to operate it, can be regarded as satisfactory. Clearing in the south is preceded by intensive and efficient soil, vegetation and topographic survey and by experimental agriculture. The progress of clearing itself is controlled by those responsible for the delimitation of the areas to be cleared and for the soil conservation system. The agricultural staff who have to work the land subsequently are closely concerned in the final stages of clearing, namely—rooting, stumping and levelling. The complex of the survey, conservation and clearing is now seen as the first phase of an agricultural operation, the reclamation of waste woodland and thicket.

Comparisons between hand clearing and clearing by machine are inevitable and valuable. Experiments are in progress, mainly in Southern Tanganyika, on the methods and costs of hand clearing and on the effects of mechanical clearing on the soil. There is no doubt that hand clearing is cheaper and less destructive than machine clearing. On the other hand, manual clearing requires a large labour force, which is not always available in tropical Africa and, in any case, presents considerable problems of administration, housing, transport and water and food supplies, and tends to fluctuate violently in numbers from season to season. Further, it is not yet clear whether hand clearing can achieve the necessary standard of freedom of the soil from roots and large pieces of debris.

It may well be that a fully mechanised clearing system will give place to one in which machines and hand labour both play a part. Much depends on the speed required: if several years are devoted to clearing, so that the phasing of operations can be accurately matched to conditions, the relative roles of hand and mechanical work may change.

Summary

The use of heavy equipment in East Africa for the clearing of bush began in Kenya before the second world war. The first major effort in Tanganyika was initiated by the East African Groundnuts Scheme in 1947 and has resulted so far in the clearing of 63,000 acres (from thicket) at Kongwa, of 65,000 acres at Urambo and about 6,000 in the Southern Province, from woodland, up to the end of 1950.

Clearing is preceded by survey. The land utilisation system is based on topography and soil conservation needs as well as on soil types.

The methods used in all three regions involve the felling of the trees, the removal of the debris, the extraction and removal of roots and stumps, and the levelling of the soil surface. During these operations or after them a soil conservation system has to be developed.

Felling is now carried out by the chain method, after a period during which trees were pushed over with bulldozers and tree-dozers. Bulldozers and forward-mounted rakes are used to pile the debris for burning. Rooting is now done mainly with heavy-duty ploughs or road rippers with or without horizontal blades, and stumps are extracted by hand with stumpers or angle-dozers. This is the most unsatisfactory phase of the operation and is also damaging to the gross structure of the soil. Research on rooting equipment is actively in progress. The removal of root and stump debris and the levelling of the soil surface are carried out with heavy towed rakes.

Details of the evolution of these methods and of the times taken in each operation are given for Kongwa and Urambo. Methods in the Southern Province are still under vigorous development, based on local experience and the results of earlier work in the other regions, but results up to the present are not sufficiently representative to justify description.

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Photos: Overseas Food Corporation.

Trials with Phyto-Active Substances

Encouraging results from experiments with phyto-active substances have, it is claimed, been obtained by research workers of Messrs. Ward, Blenkinsop and Co., Ltd., and the Murphy Chemical Co., Ltd., who have recently announced their initial findings with regard to substances that are able to influence certain functions of plants. They have shown that certain effects can be produced by treatment of certain plants with a vitamin in conjunction with another substance termed a co-reactant. A typical example is the dependency of growth hormones, such as 2,4-D or alpha-naphthalene acetic acid, on the vitamin K content of the plants. These growth hormones may alter their selectivity or effect when administered in conjunction with vitamin K. Other vitamins so far investigated to which the corresponding compound has been discovered include vitamins H and B.p.p. (pellagra-preventive factor). By means of suitable treatments the following effects have been obtained:

Greater resistance to frost, increased chlorophyll formation, i.e. greener foliage and greater assimilation, quicker germination and early growth, greater yield and larger fruit. Crops in Europe that were experimented on with success include apples, cherries, plums and pears, where sprays were used, and cereals, including maize in Southern France, sugar beet, *brassicae*, peas, beans, potatoes and tomatoes. In all these crops seedling sprays or preferably seed treatment gave desirable effects, particularly on size and quality of the crop under unfavourable growing conditions. These natural substances cannot force growth or give unnatural crops, but only help to obtain a maximum yield under conditions where control crops fail to do so.

Certain trials were conducted last year in other parts of the world primarily to investigate whether the same substances would give similar effects under entirely different growing conditions Vitamin H and its co-reactant were used as a seed dressing on groundnuts to see whether the all-important quick germination and early growth could be obtained. Results over one season in French West Africa have shown that a 20% quicker germination and a greatly improved stand could be obtained, accompanied, as was to be expected, by a darker green foliage. This has naturally reflected directly on yield.

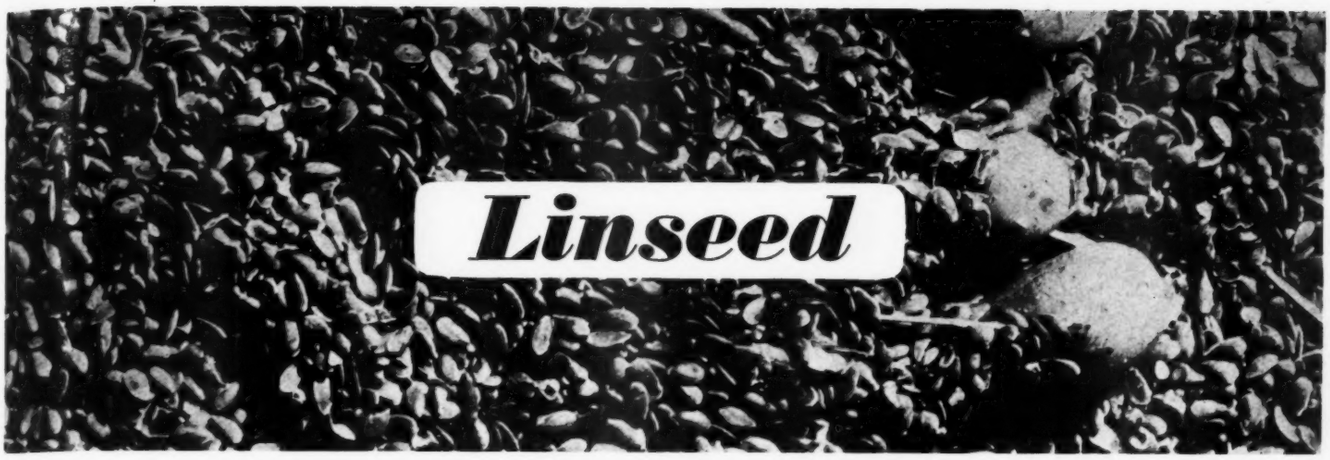
Citrus fruits were treated in Ceylon by tree injection and spraying results indicate that harvesting can take place earlier and that the fruit is larger, taste being unaffected. In Kenya dressings on seeds of sunflowers resulted in an increase of up to 10% in yield of seeds. This increase was shown to be in weight of seed harvested and not in numbers.

Potato trials in Kenya confirmed findings of large increases in this country.

It is intended to extend Colonial trials this year over a larger area and a greater number of crops. Samples of these substances, therefore, are freely available to growers and field stations who wish to experiment with them.

R.S.A. Prize—Judges' Names

The following are the judges of the Royal Society of Arts competition, for the best means of promoting the production or the economic utilisation of food in Britain: Sir Frank Smith, G.C.B., G.B.E., F.R.S. (Chairman), Professor E. N. da Costa Andrade, F.R.S., Sir John Russell, O.B.E., F.R.S., Sir James Turner (President, National Farmers' Union), and a nominee of Lord Digby (President, Royal Agricultural Society of England).



Linseed

These are the small shiny seeds from which valuable linseed oil is extracted

E. S. BUNTING

Agricultural Research Council Unit of Experimental Agronomy, Department of Agriculture, Oxford

Linseed and flax are both produced by the crop plant 'Linum usitatissimum,' and on this account the crop occupies an almost unique position. Linseed oil is by far the most important of the drying oils, and is vital in the paint and varnish industry; linseed cake is an essential feeding stuff, while flax fibre is among the most important of the finer textiles. The more important aspects of linseed production today are described and discussed below.

THE crop plant, *Linum usitatissimum*, is the source of both linseed and flax fibre. The oil extracted from linseed is the most important drying oil of commerce, whilst flax fibre is the raw material for linen textile manufacture. Since the flax fibres are obtained from the stem it is, theoretically, possible to produce both flax fibre and linseed from the same crop. In practice, however, different varieties are usually used for the two purposes, while the cultivation methods employed for the two types of crop also differ. Where, as in parts of Russia and in many European countries, 'dual purpose' crops are grown, the quality of both products suffers. The varieties which give the highest yield of good-quality fibre usually produce little seed, whilst those which yield high returns of linseed possess short, coarse fibres unsuitable for spinning fine textiles, though they may have other industrial uses.

For fibre production the length of unbranched stem is important. Fibre flax varieties, therefore, are generally taller than those grown solely for linseed production, and show less tendency to branch from the base of the stem. Moreover, since the length of the stem to the first panicle of the inflorescence is greater, they normally produce fewer flowers; hence capsule production and with it seed production is reduced.

History of flax cultivation

The distinction between fibre flax and linseed varieties is the result of centuries of selection.

L. usitatissimum is one of the oldest of cultivated plants and remains of Linum plants have been found in Swiss dwellings of the Stone Age. The actual species represented by these finds is in dispute, but it is known that *L. usitatissimum* was an important crop more than 4,000 years ago. Vavilov, from a study of material collected from all parts of the world, concluded that the oldest areas of cultivation were in south-western Asia and in the Mediterranean coastal belt. He believed that two or three different wild species united to form the present cultivated species, but a more widely held view is that wild flax, *Linum angustifolium*, which is native to the Mediterranean region, is the progenitor.

Production trends

The trend toward typical fibre flax types on the one hand and linseed types on the other was probably influenced by the geographical isolation of the two crops. Good-quality fibre can only be produced in the cool, moist climates characteristic of the northern temperate zone, whereas linseed can be successfully grown in the southern temperate and subtropical zones.

In south-western Asia, for example, the crop has always been cultivated solely for linseed and in South America, which until recently was the most important linseed-producing area in the world, the cultivation of fibre flax is relatively insignificant. The annual production of linseed in the main producing countries is shown in Table 1.

Linseed areas: South America

Argentina was by far the most important linseed-producing country in the immediate pre-war years. The crop, introduced in the latter half of the 19th century, developed rapidly in the coastal provinces of Santa Fe, Buenos Aires, Entre Rios and Cordoba. The acreage planted to linseed in Argentina rose from about 1,000,000 in 1899 to more than 8,500,000 in 1936. On average about 15% of the area sown is abandoned before harvest each year and vagaries of climate lead to considerable fluctuations in yield. The average yield of the harvested crop has varied from about 6½ cwt./acre in 1943-44 to less than 1½ cwt./acre in 1916-17.

Argentinian production continued at a high level during the early war years, but with the eventual dislocation of trade and restriction of exports, surplus stocks reached an embarrassing level. The acreage was severely reduced in 1944 and, despite the very recent increase, linseed production in Argentina is still far below the pre-war average.

The main linseed-growing area of Uruguay adjoins the Argentina border and the crop may be considered, geographically and climatically, as an extension of Argentinian plantings.

Russia

The acreage sown in Russia before the war approximately equalled that in Argen-

tina, but only in the black earth region of southern Russia is the crop grown solely for seed. The plantings in north and central Russia, representing about 85% of the total, are primarily for flax fibre and seed yields are low. Russian production is, therefore, much smaller than that of Argentina, and none is exported.

India

India has long been an important linseed-producing and exporting centre. The crop is grown solely for seed and Indian varieties are characteristically short-growing with profuse basal branching.

North America

Linseed production in North America is centred around the Great Lakes. The north central states, Minnesota, North Dakota and South Dakota produce about 90% of the total U.S.A. crop and Manitoba and Saskatchewan are the most important linseed-growing provinces in Canada. Large acreages were grown during the early years of this century, but production steadily decreased in the years between the wars. In Canada, for instance, the average acreage from 1934-38 was less than 300,000, compared with an average of rather more than 1,000,000 for the four years 1909-13. Both the U.S.A. and Canada were net importers of linseed before World War 2. War time importing difficulties, however, led to great expansion of cultivation and in 1943 the total acreage planted in Canada and U.S.A.

TABLE 1
PRODUCTION OF LINSEED (1,000 tons)

	Average 1935-39	1946	1948	1949
N. America				
U.S.A. ..	275	565	1,363	1,092
Canada ..	38	160	442	57
Mexico ..	3	20	48	50
S. America				
Argentina ..	1,489	1,018	492	640
Uruguay ..	97	71	115	73
Brazil ..	—	15	20	39
Europe				
Belgium ..	17	15	15	16
Denmark ..	—	1	18	15
France ..	12	9	10	—
Germany ..	20	20	35	27
Italy ..	5	6	12	11
Netherlands	14	8	15	17
Poland ..	39	9	—	—
Sweden ..	—	7	25	51
Gt. Britain	—	5	35	23
U.S.S.R. (Europe and Asia) ..	803	281	482	—
Asia				
Turkey ..	9	7	45	35
India ..	452	363	431	444
Pakistan ..	—	—	13	12
Africa				
Morocco ..	9	6	31	58
Australia	—	—	3	6
World total	3,339	2,640	3,784	3,496

was eight times the pre-war figure. More recently production in North America has fluctuated considerably, but it remains considerably higher than before the war.

Europe

In Europe, where most of the crops are harvested for both linseed and flax fibre, pre-war production accounted for less than 5% of the world total. However, during the war years there was a considerable increase. In Germany, for example, the annual acreage from 1940-44 averaged nearly 200,000, while in many countries where linseed cultivation had lapsed, the crop was re-established. In Sweden the acreage planted increased from 500 in 1940 to 120,000 in 1949. With linseed growing officially encouraged in Denmark and Great Britain since the war, European production in 1949 was nearly twice the pre-war average.

Africa

In Africa the cultivation of linseed is largely confined to the northern region. The North African linseeds form a distinct group, with large flat petals and very large capsules and seeds. In Morocco, the chief linseed-growing country of Africa, in Algeria and in Tunisia output during the post-war years was greatly expanded under French encouragement. In 1950, however, the linseed price granted to the farmers was lowered and a startling reduction in acreage followed.

In South Africa—and also in Australia—the cultivation of linseed has increased during recent years, although the crop remains of minor importance.

World trade

The changes in the world distribution of linseed production during the past decade are a reflection of the changing conditions of world trade. Before World War 2 more than 50% of the estimated tonnage entered international trade—a much higher proportion than that for the major food crops. Argentina and Uruguay each exported more than 90% of their total production, and these two countries, together with India, accounted for about 95% of world exports. North America and Europe were the chief importers of seed, while the much smaller trade in linseed oil was largely between European countries. The Netherlands, in particular, exported considerable quantities of linseed oil.

During the war years oil-seed crushing industries were developed in India, Uruguay and, particularly, Argentina. Much more of the crop is now retained in these countries for crushing, and linseed exports have been rigidly controlled during recent years. Prices rose to an artificially high level during the years 1946-48 and importing countries were forced to increase production. The efforts in North America were particularly successful. Canada and the U.S.A. each had an exportable surplus of linseed in 1948, but currency difficulties prevented the European countries taking advantage of these alternative sources. With the introduction of E.C.A. (Marshall Aid), trading prospects between dollar and sterling areas improved, and U.S.A. exports have increased recently. The decision to restrict purchases of linseed with Marshall Aid dollars to the U.S.A. greatly reduced the export possibilities for Canada, leading to the drastic reduction in Canadian plantings in 1949.

Cultivation and harvest

Linseed is generally grown as a spring-sown crop and the machinery and methods of cultivation are similar to those used for spring-sown cereals, but greater care is needed in preparing the seed bed to give shallow, even planting. The crop is not, as was formerly thought, very susceptible to frost injury. Young seedlings can withstand temperatures as low as 21°F. without permanent injury and the time of sowing should be selected to avoid the greater danger of drought during early development.

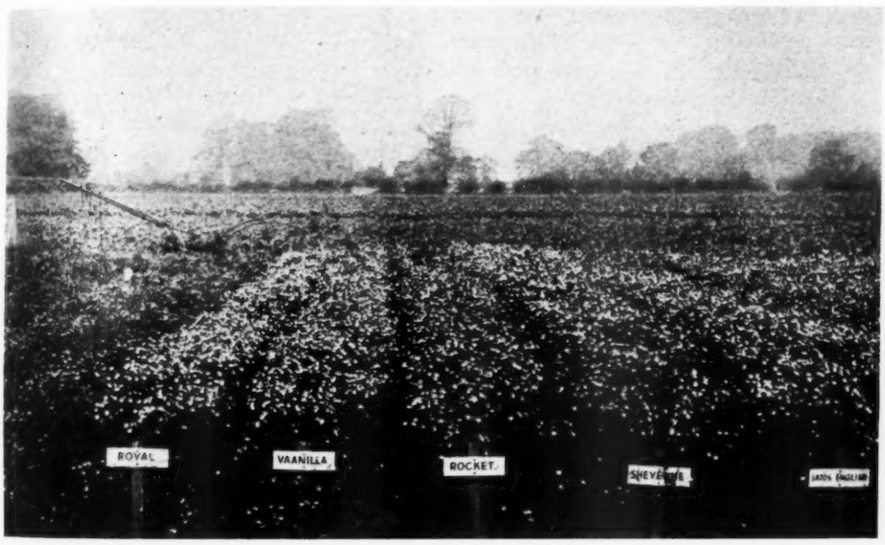
Linseed does not compete well with weeds, and this has been a principal cause of failure in the past. Fortunately recent research has shown that chemical herbi-

Harvesting linseed with a grain binder in Minnesota. The machine is adjusted to make bundles of fair size and shape

cides can be used selectively to control many of the annual weeds which are important in American and European crops.

Clean crops which ripen early may be combine-harvested directly, but a more general practice in North America is to windrow, and thresh with a combine fitted with a pick-up attachment. North American linseeds closely resemble flax types in plant habit. They are taller growing and much less prone to basal branching than the Indian, Argentinian and North African strains. Since these North American linseeds also have a much shorter flowering period than the branched types they are much more suited to mechanical harvesting. In Europe, where the climate conditions at harvest may not be so favourable for combine harvesting, the crop is usually cut with a grain binder or mowing machine, stacked and threshed when thoroughly dry. The difficulties of harvesting and threshing linseed have proved the greatest deterrents to the extension of the crop in Great Britain. The essential factors for success seem to be a very sharp power-driven knife for cutting the fibrous stem and a thoroughly dry crop for threshing.

Yields of linseed are considerably higher in north-west Europe than elsewhere. In Great Britain, where the average yield is 10 cwt./acre, individual crops giving more than 1 ton of seed to the acre have frequently been reported. Yields of this magnitude are also obtained under irrigation in California. Yields in Sweden and Denmark are like those in England, whereas in central and south-eastern Europe, Russia, India and North and South America yields average 5 cwt./acre or less.



Variety trials with linseed are carried out by the National Institute of Agricultural Botany at Cambridge in co-operation with the Department of Agriculture, Oxford

Pests and diseases

Insect pests may cause considerable damage to linseed crops in Argentina, but they are less troublesome in North America and Europe. The most important pests in Great Britain are species of flea beetle. Damage is slight on well-developed plants, but crops attacked in the cotyledon stage may be almost completely destroyed. Early sowing generally enables the crop to become established before the flea beetles are abundant, otherwise insecticidal dusts may be used for control.

The most important diseases of linseed are the fungus diseases, wilt, rust and pasmo. Wilt (*Fusarium Lini*) threatened the entire linseed-growing industry in North America during the early years of this century. In a classical piece of research, Bolley, working in North Dakota, isolated the causal fungus and bred wilt-resistant strains. The disease is soil-borne and no effective treatment other than the cultivation of wilt-resistant varieties is known. Apparently high soil temperatures are needed for the spread of the fungus and wilt has never become epidemic in the cooler European countries.

The control of rust (*Melampsora lini*) is complicated by the existence of many different strains. Nevertheless, good control has been achieved by the breeding of locally resistant varieties. Temperature also affects the spread of rust and late sown crops are much more susceptible.

Pasmo (*Sphaerella lini*) causes mottling of the stem and is more dangerous to fibre flax than linseed. Although not yet reported in British crops it has recently caused much damage in Argentina and North America. No variety completely resistant to pasmo is known, but since the disease is thought to be seed-borne, seed treatments may be effective in its control.

A shock or stook of linseed, made up of only two sheaves

In all the main producing countries linseed is regarded as a cash crop. The unprocessed seed can be fed sparingly to animals, and in India, Ethiopia, Egypt and parts of the U.S.S.R. it is still used as a human food. These practices, however, account for very little of the total production and nearly all the linseed harvested is sold off the farm to the crushing industries for linseed oil manufacture.

Chemical composition

Both varietal and environmental factors influence the chemical composition of linseed. High temperatures during flowering and the early stages of seed formation reduce the final oil content. Under normally favourable conditions linseed contains about 40% oil, expressed on a dry weight basis, but some recently introduced varieties, for example the U.S.A. variety Minerva, will average 45% oil. Linseed oil contains a high proportion of unsaturated fatty acids, principally linolenic and linoleic acids. On exposure to air these unsaturated acids absorb oxygen to form linoxyn, a tough protective compound very resistant to the effects of heat and moisture. The value of linseed oil is based upon this property of drying quickly in air. In the assessment of the drying properties it is easier to measure the

Chemical control of weeds among linseed has been successful. Note the difference between the treated and untreated portions of the field. Agronone powder was used to destroy the thistles

amount of iodine absorbed, rather than oxygen. The iodine number of an oil gives a measure of the unsaturation and, from this, the rate of drying in air. In general, cool climatic conditions are more favourable for the production of oils with a high iodine number, although varietal factors are also important.

Early breeding work with linseed was largely confined to the study of factors influencing yield and disease resistance. Recently more attention has been paid to problems of oil quantity and quality. There seems no reason to doubt that the objective—a linseed combining high oil content with a good drying quality—will eventually be achieved.

Uses of linseed

In the United States 95% of the linseed oil is taken for the manufacture of paints, varnishes, printers' inks, linoleum and oil cloth. Linseed oil accounts for about two-thirds of the total drying oils used in those industries. In addition linseed oil is a basic ingredient of core oils for the foundry industry and small quantities may be used in soap making.

Linseed, apart from oil, contains 20 to 25% protein. The linseed cake or linseed meal obtained as a by-product of linseed oil manufacture contains 30 to 40% protein and 2 to 6% oil, depending on the efficiency of the methods adopted for oil extraction. It has long been regarded as a most valuable concentrated protein feed for all classes of farm stock.

Linseed straw produces a coarse fibre unsuitable for linen manufacture. Since it does not readily rot, it also is unsatisfactory for litter or composting and it has generally been burned as a waste product. Recently, however, linseed straw has been used to some extent by various industries. Tow produced from linseed straw may be used as a packing material and in the preparation of building and insulating board, whilst spun tow has been employed for carpet backing. In Canada and the U.S.A. linseed straw is used in the manufacture of cigarette and fine bond papers; 60,000 tons of linseed fibre—about 300,000 tons of straw—are taken each year for the preparation of cigarette paper in the U.S.A. In Argentina linseed straw is now being processed into burlap, and a recent report stated that 20 factories were now producing a total of 120,000 tons of burlap annually.

Considerable efforts have been made during recent years to find a market for linseed straw from British crops, but with limited success. The most useful part of the straw—the fibre—represents 20 to 25% of the total weight. The principal need is an efficient machine to reduce crop bulk and subsequent transport costs.

An assured market for linseed straw would help to stabilise linseed cultivation, particularly in western Europe, where climatic conditions favour straw production. In the main producing countries the possibilities for crop improvement through the use of better varieties and more efficient methods of weed control are probably greater for linseed than for competing cash crops. Thus linseed may continue to be useful in agricultural economy.

Photo p. 98 : Plant Protection Ltd.

Hill Farming Act in Operation

By the end of last year 3,248 schemes for the improvement of hill farms in England and Wales had been approved or were under consideration. They related to 3,898 holdings, representing about 25% of the hill farms in the country and covering some 1,145,000 acres.

The total estimated cost of these schemes is £4,665,000, which is proportioned as follows:—

	% of Total
Farm buildings	22
Farm houses	13
Farm cottages	4
Roads, bridges	6
Water supply	4
Electricity	3
Pens, dipping accommodation	2
Silos	*
Fencing	10
Grids	*
Drainage	4
Reclamation of waste land	*
Shelter belts	1
Liming	5
Manuring, reseeding, permanent pasture	16
Removal of bracken	1
Machinery	*
Pest destruction	*
Unspecified (costs supplied relate to a number of improvements and no reasonable apportionment can be made)	9
	100

* Less than 1%.

Although the consideration and approval of schemes takes some time, applicants may go ahead with the work once they have obtained authority to start from the Land Commissioner with the understanding that a grant will be paid if the work is done satisfactorily and is later included in an approved scheme. Authority of this kind has been given for well over half the total number of schemes.

After a scheme has been approved it is the applicant who sets the pace, as he is responsible for getting the work done, and may spread it over several years.

At the end of 1950, the estimated cost of all live schemes for the whole of the United Kingdom was £8,740,000. Under the Hill Farming Act only £4 million are at present available for grant. The Livestock Rearing Bill, which is now before Parliament, is intended to amend and extend the Act. In particular, it (i) widens the class of land eligible for improvement grant so as to include livestock rearing land on the lower slopes of the hills in the upland areas, (ii) extends by five years the period during which schemes may be submitted, and (iii) increases the funds available for grant to £20 million.

Tropical Grasses as Concentrated Feeding Stuffs

C. A. SHACKLADY

The production of concentrated foodstuffs by artificial drying of grass is attracting ever-increasing attention. It has been suggested in some quarters that the extension of the practice to tropical countries, where growth is so lush in rainy periods, might provide large additional fodder resources capable of being exported. The author examines this thesis and concludes that by reason of the composition of tropical grasses expectations of development of this nature are largely illusory.

THE rapidity of growth and lushness of certain tropical grasses has prompted the thought that they might provide a good source of concentrated food if they were conserved in the young stage. It is now generally recognised that dehydration at comparatively high temperatures conserves the highest percentage of nutrients and accordingly this method of concentration has been suggested.

Production considerations

As a preliminary it is necessary to determine whether tropical grasses are, in fact, capable of producing concentrates in the sense in which that term is generally used in England. Concentrates are defined as either (a) protein concentrates, examples of which are the majority of oilcakes, or (b) cereal concentrates like the pure cereal grains, or (c) a mixture of the two. In the last case the mixture is designed to provide both protein and starch equivalent in the proportions required for milk or meat production, in which case they are commonly referred to as 'balanced' concentrates.

The best quality of grass produced in the British Isles and dehydrated at the earliest practicable stage of growth is not as high in starch equivalent as the cereals, with the possible exception of oats. Nor does its protein content compare with that of such oil cakes as groundnut, linseed, soya-bean, etc. On the other hand, it may often attain the protein content of palm kernel cake, coconut cake (poonac), shea nut cake, undecorticated cotton cake and mustard cake. It is quite possible, however, to produce a balanced concentrate from grass alone or from a mixture of grass and legume.

Available information does not, however, suggest that tropical grasses would lend themselves to the production of concentrates. Paterson[1], who made a preliminary investigation of the feeding value of artificially dried fodder crops in Trinidad, concluded that none of the grasses examined were suitable for the production of a dried grass concentrate, even when they were harvested at fortnightly intervals and were, therefore, in a very immature state. The grasses upon which he reported were Savannah Grass (*Axonopus compressus*, Beauv.), Para Grass (*Panicum barbinode*, Trinidad), and two varieties of Elephant Grass or Napier Grass (*Pennisetum purpureum*, var. Uganda and Schumach).

Causes of unsuitability

The unsuitability of a grass for drying may be due among other reasons to (a) a very high moisture content rendering drying uneconomical and (b) the low nutritive value of the final product.

Various methods are available for reducing moisture contents prior to drying, of which the practice of wilting and the use of a stem crusher are probably the most widespread. It is obviously an advantage to reduce the amount of water which has to be removed by heat obtained by the burning of fuel, as even such a comparatively small increase in moisture content as 5% will reduce the output per hour of dried material by 25%. When this is translated into terms of fuel and labour costs per ton of dried material, on the grounds of succulence alone some tropical grasses would be near the economic limit. In Paterson's trials neither of the two varieties of Elephant Grass contained sufficient dry matter to justify conservation; the mean contents being 13.42% for the Schumach and 13.25% for the Uganda variety. Even Para Grass with dry matter content of 19.42% could be regarded as only moderately satisfactory as also could Paspalum with approximately 20% of dry matter.

In any event stem crushing and wilting are not entirely satisfactory processes as both involve some loss of digestible nutrients. Wilting, in particular, rapidly reduces the carotene content and in both crushing and wilting there is a tendency to lose some of the carbohydrates by respiration. Any system of reducing moisture contents before artificial dehydration is commenced therefore, involves a compromise between loss of moisture and loss of nutrients.

Nutrient value of tropical grasses

The most striking difference between tropical grasses and those of the temperate zones lies, however, not in their moisture contents, but in their nutritive values since it is the latter which determine their suitability or otherwise as concentrates. Watson[2] in his comprehensive survey of fodder conservation established regression equations for calculating the starch and protein equivalents of dried grass and dried lucerne; he showed that on grass and ley mixtures predominantly grass, there is a direct relationship between the crude protein content and the starch and protein equivalents. The equations show very good agreement with results obtained under practical conditions and indicate that dried grass of 16-18% protein content is a satisfactory balanced concentrate for milk production.

Schneider[3] has recorded figures for the composition and digestibility of a large number of fodder crops including some of the tropical grasses.

As examples the following may be cited:

Bermuda grass (*Cynodon dactylon*).
Buffalo grass (*Buchloe dactyloides*).
Gamagrass Guatemala (*Tripsacum laxum*).
Guinea grass (*Panicum maximum*).
Napier grass (Elephant grass) (*Pennisetum purpureum*).
Para grass (*Panicum purpurascens*).

Paspalum (*Paspalum fasciculatum*).
Rhodes grass (*Chloris gayana*).

Taking these in order and using Schneider's figures as a basis for calculation, starch equivalent and digestible crude protein contents would be as follows, calculated to a basis of 10% moisture content which can be assumed as that which would occur in practice :

Grass	*Starch Equivalent* lb. per 100 lb.*	*Digestible Crude Protein lb. per 100 lb.*
Bermuda (a)	33.4	5.4
Buffalo (a)	42.7	5.9
Guatemala Gama (b)	37.9	4.8
Guinea (b)	36.0	3.4
Napier (c)	51.3	7.3
Para	39.8	5.0
Paspalum (b)	35.0	2.9
Rhodes (b)	42.8	4.1

(a) : Immature, dried.
(b) : Calculated from nutrients fed green.
(c) : Very immature fed green.

Comparison with British grasses

These values may be compared with those for dried ley grasses in the British Isles, with a protein content of 18% at a moisture level of 10%. The starch equivalent would be 50 lb. and the digestible crude protein 13 lb. per 100 lb.

Such a food can rightly be regarded as a balanced concentrate, 5 lb. of it would supply enough starch equivalent for one gallon of 3.5-3.8% butterfat milk and rather more (0.65 lb.) digestible crude protein than the theoretical requirement. It could, in fact, be compounded with a food of lower protein content, e.g., barley or maize, to economise in protein and bulk, while 3½ lb. of the dried grass plus 1 lb. of either cereal would still contain all the nutrients required to produce one gallon of milk.

The tropical grasses, however, present an entirely different picture. With the exception of Napier grass none of them approach in feeding value the dried ley mixture. Napier grass may, it is true, have an equivalent energy value weight for weight, but its protein content falls far below that required for a balanced concentrate. In fact 7 lb. of it would be needed to provide enough protein for a gallon of milk, whereas this quantity of the British product would supply enough energy for almost 1½ gallons.*

The other dried grasses cannot be regarded as much better than maintenance foods ; in the case of Paspalum the S.E./D.C.P. ratio is too wide even for maintenance for which a ratio 10 : 1 is required, while Rhodes grass and Guinea grass are also both on the borderline. It is possible to produce meadow hay in England with a starch equivalent as high as Rhodes grass and a digestible crude protein as high as Buffalo grass. It must, however, be admitted that the figures for Guinea grass more nearly approximate to those for average quality meadow hay, the digestible crude protein being perhaps a little lower than would be expected in the hay.

A further comparison

It is interesting to compare theoretically balanced rations for, say, maintenance and the production of one gallon of milk on the assumption that dried tropical grasses were available for feeding to stock in this country.

In the case of an animal of 11 cwt. liveweight producing milk of 3.7% butterfat content, the total nutritive requirements for maintenance and one gallon of milk production would be 9.5 lb. of starch equivalent and a minimum of 1.24 lb. of digestible crude protein. With seeds hay of maintenance quality and British dried grass containing 18% of protein at a 10% moisture level the ration could be :

	Starch Equivalent lb.	*Digestible Crude Protein lb.*
23 lb. hay	7.0	0.70
3½ lb. dried grass	1.75	0.45
1 lb. maize	0.77	0.08
	9.52	1.23

Considering Napier grass as the highest in nutritive value of the tropical grasses it is evident that no cereal would be permissible in a ration containing it because of the wide S.E./D.C.P. ratio already present in the hay and dried green crop. A possible ration might for example be :

	Starch Equivalent lb.	*Digestible Protein Content lb.*
23 lb. hay	7.0	0.70
7 lb. Napier grass dried	3.6	0.51
	10.6	1.21

This ration, in order to provide enough protein for maintenance and production of one gallon of milk, would supply more starch equivalent than is required for the same purpose, while the dry matter content has increased to 27 lb. which is far too bulky, particularly for the higher yielding cow requiring further concentrate feeding.

Within practical limits the other tropical grasses would all require the addition of protein concentrates if they were to be included in a production ration. It is true that they could be used to supply the maintenance part of the ration, *e.g.* 20 lb. of dried Guinea grass would cover the maintenance of requirements of an 11 cwt. beast, but to it 4-4½ lb. of balanced concentrates would have to be added to produce one gallon of milk.

Paspalum, on the other hand, would require protein supplementation even to qualify as a maintenance ration, since although 20 lb. of the dried material would supply starch equivalent sufficient for maintenance energy requirements, it would provide only about 80% of the protein needed, and in fact, something like ¼ to ⅓ lb. of groundnut cake would be required to redress the balance.

Feeding value of fresh grasses

So far this article has dealt with dried tropical grasses, but similar arguments apply to the feeding value of the green material. The availability of nutrients in the green and artificially dried crops remains constant at about 91-94% for each and it is accepted that properly dried grass retains the nutritive value of the fresh crop ; all that is needed to convert the figures previously given to a green crop basis is to adjust them on the basis of their moisture contents. Thus, if the dried crop contains 10% of moisture and the fresh crop 80%, 4.5 lb. of green crop will be needed to replace 1 lb. of the dried material.

It follows that even 90 lb. of fresh Paspalum would not suffice for the maintenance of an 11 cwt. beast but would require the addition to the ration as before, of ¼ to ⅓ lb. of groundnut cake (decorticated). This basis is striking if it is compared with good English pasturage which will easily support a production level of 2½ or more gallons of milk without further supplementation. In fact the limiting factor on the production value of English pastures is primarily one of starch rather than protein equivalent and supplementing good grazing with cereal concentrates and, where necessary, minerals ; considerably higher levels of production than 2½ gallons are possible at the peak grazing period. New Zealand claims to

* Starch Equivalent = Digestible crude protein + digestible crude fibre + 2.25 (digestible ether extract) + digestible nitrogen-free extract + 0.29 (crude fibre). The correction factor of 0.29 for fibre has been chosen because although the fibre content might appear to justify one of 0.58, that of the green crop would not. It is known that artificial drying has no measurable effect on the digestibility of individual constituents and there thus appears no justification for applying a correction factor of 0.58 to a food that before dehydration would only have required a correction factor of 0.29.

* It may be noted that although Paterson obtained such low dry matter contents for the varieties of Elephant grass which he investigated, Schneider's figures indicate a higher dry matter content of 20.8 per cent. The variety of Napier grass is not stated in Schneider's publication.

produce 5 gallons or more of milk from pasture alone and has a much longer grazing season than Great Britain.

Conclusion

It would appear, therefore, that by reason of their composition the tropical grasses enumerated cannot be expected to assist in solving the problem of a world shortage of concentrated food for cattle. On the contrary some, at least, scarcely provide adequate maintenance ration unless they are supplemented by high protein concentrates. This raises the point whether oilseed producing tropical countries are economically justified in exporting high protein content commodities while their own livestock are urgently in need of them. There seems no obvious reason why the oilseeds should not be crushed in the country of production and the oil exported while the press cake is retained for domestic consumption. Indeed, it seems the height of folly to export oil cakes until the needs of a country's livestock population have been met. It seems reasonable to suppose that with improvement in animal husbandry in tropical countries and in particular increased production of dairy produce from improved strains of dairy cattle, the demand for concentrates will continue to expand, until ultimately a balance is established.

Under these conditions dairy farmers in temperate countries should be able to reduce their requirements for imported press cake concentrates by increased and improved grass conservation and better understanding of the nutritive value of this type of fodder. In the U.K. at present, in many cases, grass is neither grazed, fed, nor conserved economically, and until matters in this regard have been improved the demand for imported protein is bound to continue.

No doubt there will always be some need for imported oil cakes, but the tropical livestock producer also needs them badly. In these circumstances it is only obvious commonsense that he should aim at retaining enough in the country of origin to satisfy his own requirements and only export surplus quantities after his own needs have been met. Temperate countries can, and do, produce a part of their requirements for balanced concentrates from their own grass ; the tropical farmer on the other hand does not, cannot, and never will.

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Picking and weighing seed cotton from the plots of a variety trial

Cotton Research in the Commonwealth

In our issue for January we published a description of the newly opened Central Cotton Research Station of the Empire Cotton Growing Corporation at Namulonge in Uganda. In the following article the experimental work carried out by the Corporation in various parts of the Commonwealth is described and reviewed.

THE progress reports of cotton experimental stations in the season 1948-1949, published by the Empire Cotton Growing Corporation* cover the initial work at the Central Research Station, recently established in Uganda, and at Stations in South Africa, Uganda, Anglo-Egyptian Sudan, Tanganyika Territory, Nyasaland, Southern Rhodesia, Nigeria, the West Indies and Queensland. The area planted with cotton within these regions is only about 8% of world acreage under this crop, but the value of this area as well as of the work at the Stations should not be judged by the acreage alone, but on the importance of extending cotton growing in the Empire.

Cotton being an annual crop, acreages fluctuate according to price; thus in the West Indies' report competition with other crops is particularly noticeable in St. Vincent, but similar fluctations occur elsewhere.

Climatic conditions

In most countries the year proved favourable; it was particularly good in the West Indies, but in parts of Africa, particularly in Tanganyika and Nyasaland, an unusually severe drought materially affected yields. In Nyasaland insects limited yield to a greater extent than the sparse and erratic rainfall.

Climatic conditions in relation to cotton were studied at the Barberton Station. Conditions over much of the area are marginal for cotton and a minimum mean annual rainfall of 20 in. appears necessary for cotton production. Higher temperatures at planting in South Africa are associated with more rapid germination than is usual in the United States, and the relatively lower temperature at the fruiting stage is associated with a longer period of boll development in the South African crops. Preliminary investigations in South Africa showed that variations in rainfall after planting have no significant effect on yield, but there appears to be a highly significant correlation between yield and rainfall during the five weeks prior to

* Progress Reports from Experimental Stations, 1948-1949, pp. 172. Empire Cotton Growing Corporation, 12 Chantrey House, Eccleston Street, London, S.W.1. 1950. 3s.

planting. Similar results have been found in the Sudan. This association shows the drought resistance of the crop once established, and throws light on the value of early as opposed to late planting.

Varieties and breeding

Breeding is used not only to improve the quality and yield, but to control diseases and pests. This, however, cannot be done for the conditions in one region by stations in others, and it has been amply demonstrated that varieties bred at other stations usually fail to give good results when imported elsewhere.

The Central Research Station maintains a live collection of the world's cottons in the Sudan. A study has been made of the distribution of the four species which contribute to the world's cotton crops, and data is available for the compilation of an account of the introduction and spread of cotton in Africa.

There appears to be considerable scope for further improvement of yield by breeding. The Uganda report states that one object is to assess the likelihood of yield improvement, and concludes that genetic variability is still very high both for yield and for some morphological characters; with an efficient system of selection, therefore, real genetic advances may be expected.

Much of the breeding work is concerned with producing strains resistant to diseases and pests. Pests are in many areas the most important limiting factor to yield, and also often affect quality. It is essential, however, to ensure that resistance is not accompanied by decreased yields; moreover in Southern Rhodesia it is considered that, with the exception of jassid resistance and possibly bollworm resistance, it is unlikely that improvement in yield will follow breeding methods which result in partial immunity to insect pests. The recognition of these limitations, however, does not deny the importance of breeding for resistance, nor the success already achieved in this direction. The Central Research Station report states that the whole type collection has been surveyed for resistance to Blackarm and Leaf Curl diseases. This should be of great value in planning further breeding work, and is the first fruit of the Corporation policy of bringing genetics and plant breeding into closer association.

Diseases and pests

Crop losses due to Blackarm (*Xanthomonas malvacearum*) are considered the most important single factor affecting yield in Uganda, while the prominence given to this disease in other reports indicates its seriousness in most of the cotton-growing areas. In Uganda early rainfall reduces the incidence of the disease but rainfall later in the year favours it. In Nyasaland storms and high winds favour infection with Blackarm.

Mr. F. R. Parnell speaking at the opening ceremony of the new Cotton Research Station at Namulonge, Uganda

Verticillum Wilt is serious in some areas. In South Africa it is spreading and may constitute a major breeding problem of the future, as all strains at present grown are susceptible. At the Barberton Station good results followed the removal of crop debris from the field. There was, however, no difference between manurial treatments in respect of the incidence of the disease. All evidence indicates that the association between factors affecting wilt disease and soil fertility arises through the effect of the latter on carry-over persistence, and increase of soil infestation by the pathogen rather than by direct effect on host nutrition and development. Evidence is advanced to prove that the crop will withstand the effects of the disease better at a high level of nutrition than at a low level. The yields of some susceptible strains under severe wilt incidence have been maintained at a surprisingly high level compared with those of resistant strains, suggesting that the incidence of wilt disease in any one plant has caused, by reduction of its competitive effect on its neighbours, compensatory increased growth and yield in the latter.

The three red bollworms, Sudan, American and Spiny, jassids and stainers are the most widespread and serious of the pests. In South Africa, red bollworm and stainers, as well as precarious rainfall, make cotton growing uneconomic, except possibly in times of high prices. In Tanganyika the use of DDT and gammexane dust was found to reduce very considerably damage caused by American bollworm. In Nigeria a survey showed that no single species of bollworm was entirely responsible for the damage. Heavy aphis attacks are mentioned in connection with a long drought in South Africa. Stainers are mentioned in almost all the reports. Attempts to parasitise them with tachinids appear to have been unsuccessful. In Nyasaland stainers are a source of trouble because of the lateness and irregularity of the crop. It is suggested that the vigorous convection currents and powerful sea breezes characteristic of the Barberton area may contribute to the movement of stainer population.

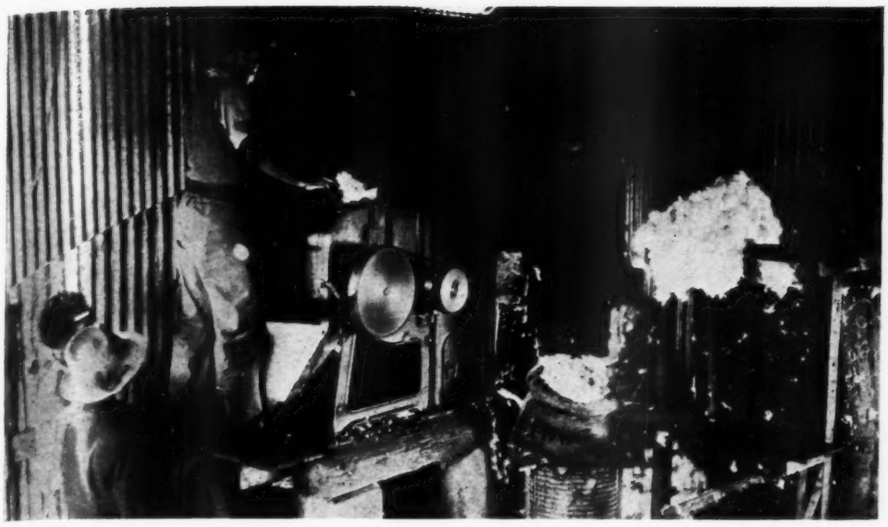
Jassid infections are very severe at times. Breeding for jassid resistance in the Sudan takes advantage of hairiness as a repellant of the pest. At Barberton, jassid infestation was most severe, though the majority of good hybrid strains exhibited full resistance.

In the Western Province of South Nigeria the control of *Heliopeltis* by means of insecticides was successful. In Queensland spraying with DDT was effective against *Heliothis armigera* Hbn.

The value of a close season in the control of pests and diseases, particularly red bollworm and stainers, is stressed in several reports. It is enforced in the West Indies and in the Barberton area of South Africa. In Nigeria it is considered that a properly enforced close season in the northern belt would have some controlling effect on *Diparopsis*, *Earias* and *Platyedra*.

Manuring

Manurial experiments in several countries have shown the value of phosphates. In Nigeria an application of 50 lb. per acre of superphosphate is stated to have been highly remunerative. In the West Indies increases of growth and yield followed the



Ginning multiplication bulks on a 40-saw power-driven gin

application of phosphate and of pen manure, while in Tanganyika 3 tons per acre of compost gave an increase in crop of 64%, and 300 lb. of superphosphate gave a 71% increase. A 36% increase of yield was obtained from a 7 ton per acre dressing of farmyard manure applied five seasons previously, and a similar response was obtained from cotton seed ash. The indications are that phosphate is probably the nutrient mainly concerned in these residual responses.

In Montserrat, nitrogen was found to be profitable on the lighter soils. At the St. Vincent Station the value of nitrogenous manures was amply demonstrated and the application of coconut and cotton seed meals gave the same results as nitrogen or sulphate of ammonia. Increases of sulphate of ammonia over the recommended rates depressed yields. The addition of potash to the sulphate of ammonia gave the highest yields.

Cultural

Interesting experiments are in progress in Queensland concerning mechanical harvesting and irrigation. The mechanisation of harvesting has been found to necessitate a plant which matures most of its crop within a short period and which has an open habit of growth. Irrigation experiments were concerned with time and rate of spray irrigation, a combined varietal and rotation experiment, and varietal trials.

In South Africa maize is the chief rotation crop, but others are under trial. In Tanganyika cotton in the first year after a planted grass-legume fallow of three years' duration showed a 30% yield increase over the continuous unmanured cropping. Permanent rotation experiments are in progress in Nigeria. At the Kadugli Station in the Sudan it is stated that under local conditions date of planting has had a greater effect on yield than spacing, spacing than plants per ' hill,' and plants per ' hill ' than variety, and the time of planting is more important than the strain. The Station is testing other crops to rotate with cotton. The West Indian report stresses the need of a planned rotation system for cotton. In most of the countries included in this volume, breeding appears to have overshadowed other investigations. One imagines that when breeding work is more firmly established, attention will be focused on cultural investigations, for surely the importance of this aspect cannot be overestimated.

Conclusion

Taken as a whole the report covers a field of very wide range and one can think of no other crop in respect of which coordinated investigations are being carried out over such a wide variety of conditions. Moreover, the broad lines on which the investigations are conceived and the fact that they include research not only on the cotton crop itself but also on systems of agriculture in which cotton plays a part greatly enhances their value. In the past the work of the Corporation has played a part of great importance in extending cotton cultivation in the Commonwealth; with the inauguration of the new Central Research Station in Uganda one can confidently anticipate that the work will gain still further importance and value in the future.

D.H.G.

Photos : Empire Cotton Growing Corporation

Serious Form of Fowl Pest in U.K.

Anxiety that there may be a serious shortage of eggs in Britain as a result of a new and highly infectious form of fowl pest is being felt by British poultry keepers. Outbreaks have been occurring since October, when the disease, which is caused by a virus, was first noticed in East Anglia. Since then it has spread widely in that part of the country owing to its highly infectious nature, and outbreaks have occurred in other areas as well.

At a press conference held in London Professor T. Dalling, Chief Veterinary Officer of the Ministry of Agriculture, described the disease and its dangers. The new form, similar to that encountered in America, is less virulent than the European type of fowl pest previously experienced in Britain and there are fewer deaths from it. Infected birds show a sudden decrease in egg yield and eventually lay no eggs at all for several weeks until they recover. If the disease becomes endemic in the country national egg production will be bound to decrease; also a higher mortality may be expected from young chicks and growing birds. The Ministry have imposed various restrictions to try and arrest the spread, prohibiting poultry store markets and shows in England and Wales, prohibiting movement of live poultry (except birds going to market for immediate slaughter) out of East Anglia, from England and Wales into Scotland and from any premises on to which live poultry have been moved within the previous 28 days.

Infected birds are slaughtered and by the end of January about 65,000 birds had been destroyed and burnt or buried; this entailed the paying out of some £100,000 compensation by the Ministry. It was felt that if matters become worse the slaughter policy will have to be abandoned and possibly some form of vaccination introduced, which would be extremely costly and less effective.

Timber anxiety

Anxiety is felt in Portuguese East Africa about the continued inroads made upon its timber resources. Clearance of forest land for cotton and other crops and periodic burning by natives are blamed, as well as heavy felling. Licences for timber cutting bring in an annual revenue to the State of over Esc. 6 millions, whereas in the 1950 budget only Esc. 3 millions are allocated for re-afforestation. It is feared that Mozambique may eventually lose an important source of wealth and that danger of soil erosion may arise.

One Year's Agricultural Aviation in Israel

J. PALTI and S. J. ELLERN

The use of the aeroplane for dusting and spraying as well as for the application of fertilisers to crops is now widespread in the U.S.A., but in other parts of the world its use is as yet much more restricted. The following account of some recent developments in Israel as the result of the initiative of a private company is accordingly of interest.

A PLAN to utilise in Israel the experience gained in the United States in agricultural aviation, notably in the application of chemicals from the air, was first put forward in 1948 and immediately found the support of the Israel authorities. A private company named Chim-Avir Ltd. was founded for the purpose and its aviation expert, Mr. W. van Leer, toured the United States and European countries to gather the latest information and purchase equipment.

Originally helicopters were to be included in the equipment, but this plan was dropped. The maintenance of an adequate fleet of helicopters thousands of miles from the nearest source of spare parts was found to be a formidable task, with little chance of economic success. The aerial equipment purchased, therefore, consisted of three Piper Cub aircraft, two equipped for spraying and one for dusting. Two Stearman biplanes convertible for either spraying or dusting were added after five months' operation and two further planes of the same type after 12 months.

Tests under supervision of the Government plant protection service impressed farmers with the possibilities of aerial spraying and dusting. A large part of Israel's agriculture is organised in communal settlements with a high technical standard and a readiness to take advantage of every advance in farming practice, comparatively rare in farming communities. Moreover, skilled farm labour is scarce in Israel nowadays and the cultivated area, both under irrigation and dry farming, is growing rapidly. Much of the soil is heavy and cannot be worked with ground equipment during the rainy season.

All these factors worked together to give the company, which started actual operation in autumn 1949, an unexpected measure of success in their first year of agricultural flying. The problems tackled to the satisfaction of farmers are outlined below.

Weed control spraying

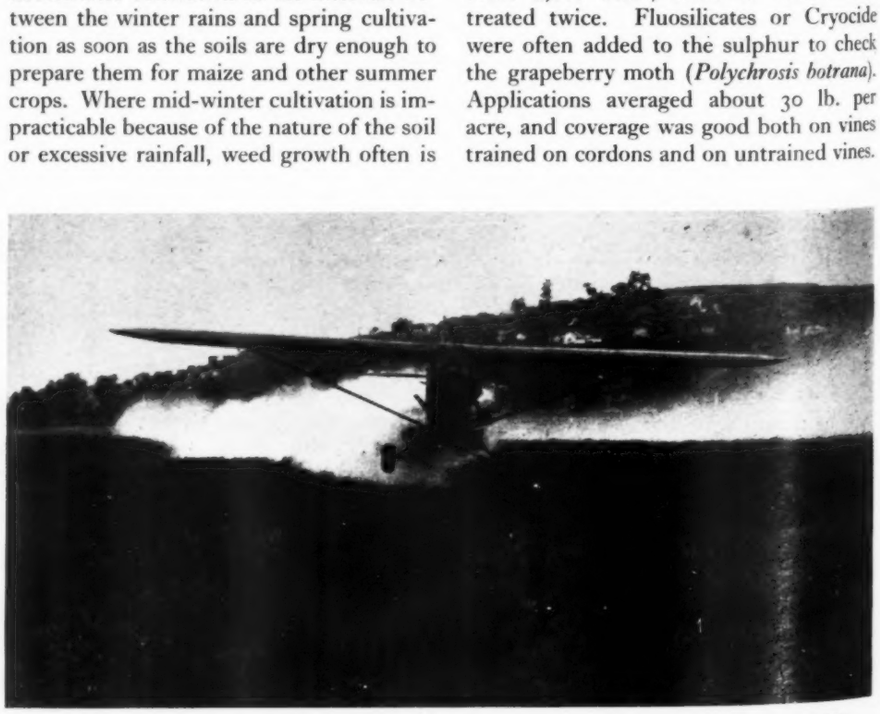
Winter cereals. These were treated with 2,4-D (Kathon M-7) and MCPA (Agroxone 3) sprays. A total of 6,000 acres were treated, mostly at the rate of 250-350 g. of 2,4-D equivalent in 4 gal. of spray per acre. All major weeds on heavy soils were controlled. On sandy soils the most dangerous weed, a species of *Anthemis*, was checked by spraying with 500 g. 2,4-D equivalent per acre. Malformation of about 10% of the ears resulted from the spray in a field of wheat of a local variety treated before tillering.

Preparation for summer crops. The rich winter weed flora of the heavy soils necessitates cultivation in the intervals between the winter rains and spring cultivation as soon as the soils are dry enough to prepare them for maize and other summer crops. Where mid-winter cultivation is impracticable because of the nature of the soil or excessive rainfall, weed growth often is so dense that recourse is had to ploughing to turn it in. This entails extensive loss of soil moisture so vital for summer crops in an arid climate. Aerial spraying in February on an area of about 1,000 acres destroyed the dominant weeds of the charlock and wild carrot type while still in the seedling stage. Maize could be sown on these fields without further cultivation; this resulted in the conservation of soil moisture and advanced the sowing date by four to six weeks.

Other weed control work. A few hundred acres of land were also treated from the air with various 2,4-D preparations (*a*) to control bindweed infestation in summer cereals, (*b*) to destroy thistles on mountainous slopes and thus facilitate stone clearing, the essential prelude to their cultivation, and (*c*) to check the growth on airfields of mesquite (*Prosopis* sp.), which pushes through the asphalt cover of the runways.

Pest control dusting

Sulphur dusting of grape vines to control powdery mildew was carried out on some 2,000 acres, some of which were treated twice. Fluosilicates or Cryocide were often added to the sulphur to check the grapeberry moth (*Polychrosis botrana*). Applications averaged about 30 lb. per acre, and coverage was good both on vines trained on cordons and on untrained vines.



A Piper Cub airplane dusting vetches with a mixture of sulphur and DDT

Stearman bi-plane spraying wheat for control of weeds

Sulphur dusting of citrus crops to control rust mite (*Phyllocoptes* sp.) and red spider was a major operation in the summer months. Almost 5,000 acres were treated at a rate of 30-40 lb. per acre. This represents about half the customary rate of application; the results were excellent even in severely affected orange, grapefruit and lemon groves with their dense foliage.

Dusting tomatoes with a mixture of sulphur and DDT to control powdery mildew (*Oidiopsis taurica*), red spider and the bug *Cyrtopeltis tenuis* has made the aeroplane popular in the winter tomato-growing areas in the Upper Jordan Valley. Plots ranging from 2 to 15 acres along the shores of the Sea of Galilee and on the banks of the River Jordan were given six weekly applications. As no landing field is available in the Jordan Valley, the planes here had to land on and take off from the main road.

Various insecticidal dustings completed satisfactorily on a few hundred acres included Cryocide dusting for the control of *Heliothis armigera* on maize and of various noctuid caterpillars on water melons and safflower, DDT dusting of *Prodenia litura* on clover and lucerne, and BHC dusting of the leaf miner, *Syringopais temperatella*, on wheat and barley.

Aircraft dusting: pros and cons

The experience of the first 12 months permits certain conclusions concerning the use and limitations of this type of equipment. The advantages of aircraft for treatments where the ground is wet or on tall crops is obvious and here the plane has no competitor. However, on lower crops and dry soils the pros and cons of aerial treatment must be weighed against those of modern ground machinery.

Rate of application. In general, it was found that, where equal efficiency for both types of equipment was established, dust application to orchards and groves by plane saves both material and labour as compared with dusting by motor dusters. On the other hand, young and low field crops through which a motor duster can readily be driven are always more economically dusted by these machines than by the aeroplane. As to the rate of application of dusts, this seemed almost inversely proportional to the height of the crop, an apparently paradoxical conclusion. We succeeded in covering the most densely foliated grapefruit trees with dusts at the rate of 30 lb. per acre. On well-developed tomatoes satisfactory coverage usually necessitated application of 45-50 lb. per acre, and on young maize even this was inadequate. This is partly explained by the prevalent wind conditions. When treating trees, most of the dust released by the plane swirls into the crown and is retained there with little loss. But on lower crops increasingly large parts of the dust swirl are carried away by light winds before they can settle on the leaves. This necessitates dusting low crops with an excess of material if the essential minimum is to be retained by the foliage.

Dust diluents. It follows that a decisive factor in dusting crops from the air is the nature of the dust diluent employed. Very light fillers, which may be perfectly satisfactory for ground dusting, were found unsuitable for aircraft dusting, since they drifted far too much. The desiderata for aerial dust diluents were found to be related to the height and density of the crop to be dusted. On trees and other tall and dense crops, where a certain amount of billowing is welcome, the diluent may be moderately light; on low and especially on sparse young field crops, however, the diluent should be rather heavier to avoid excessive drift loss. It was concluded that not only should manufacturers pay much more attention to the formulation of special dusts for aircraft application, but the aircraft operator should have the choice of various diluents, according to the crop he wishes to dust.

Crop damage. While there were some minor cases of damage to legumes growing adjacent to grainfields sprayed with 2,4-D or MCPA for weed control, these were negligible compared with damage caused by ground equipment. This was due mainly to three factors. Firstly, aircraft applied 2,4-D and MCPA only as sprays, whereas ground applications consisted usually of dusting. Secondly, flying operations were interrupted as soon as wind velocity rose later in the day. In one or two cases where this was done a little too late damage due to spray drift occurred. Thirdly, sketch maps showing susceptible crops were prepared for each operation, guard strips were left untreated where necessary, and both pilots and flagmen were thoroughly briefed on the dangers of 2,4-D to broad-leaved crops.

Ancillary services

To help to popularise air treatment the company offered farmers not only treatment of their crops, but also instruction and advice concerning the treatments and—last but not least—procured the necessary chemicals. This service, what the Americans call a 'package deal,' evidently appealed to farmers who frequently ordered treatments they could very well carry out with their ground equipment, because they wished to secure advice and chemicals from the company. An important conclusion is that an undertaking contracting for pest and weed control work needs a large field staff not only to advise farmers, but also to spot the troubles amenable to treatment before they have developed beyond the stage where treatments are effective.

Conclusions

Agricultural aviation in Israel is still in its infancy. But apart from the problems already tackled commercially, as described above, many and diverse problems are still treated experimentally. The coming season will see seeding and fertilising from the air as well as bait spreading and dust or spray applications in the current locust campaign.

The first year's progress was not lightly achieved. Two aircraft were lost in operation and one pilot met his death.

Power Dusting Against Blister Blight

Minimum Copper Content Dusts Being Used in Southern India Investigations

PETER DE JONG

United Planters' Association of Southern India

Dusting tea against the Tea Mosquito in Central Travancore, Southern India

THE problems associated with the control of blister blight in tea have already been discussed in WORLD CROPS (August 1950) and a summary of the conclusions reached at the Symposium on Blister Blight Control held in Ceylon in November 1949 has been given.

At this symposium opinion suggested that any form of large-scale operation against the disease on tea in bearing could not at present be envisaged, due to technical difficulties and the lack of a suitable fungicide.

The critical period

In Southern India the industry was already fully alive to the possibility of protecting tea in nurseries and new clearings with copper sprays and measures of cultural control had already been introduced, which considerably reduced the extent of damage by the fungus to tea recovering from the prune. The problem lay in protecting tea in plucking, not only with the intention of saving crop, but also in order to minimise capital damage to the bush, the extent of which it is impossible to assess in monetary terms, but which, after only three years' experience of the disease, is becoming all too apparent in some districts. It was the opinion of the Scientific Department of the United Planters' Association of Southern India that if tea in bearing could be to some extent protected from the disease during the critical periods of disease establishment in April-May and August-September a considerable degree of control should be achieved.

Tea mosquito dustings

From the point of view of field technique, in our opinion knapsack spraying of large areas of tea at 7/10-day intervals was out of the question, necessitating, as it would, high capital outlay on equipment, considerable organisation and supervision of labour and adequate supplies of water for spraying, which are often, alas, not readily available.

However, there was a wealth of experience of field-scale dusting of mature tea to control the tea mosquito, in which spectacular results had been obtained, using power-dusting machinery and covering areas at a rate of up to 40 acres per hour. It was decided to try and apply the experience gained in this sphere to the control of blister blight.

The only fungicides of proven value were based on copper, but hitherto it had been considered that indiscriminate use of copper fungicides on tea in bearing might raise the copper contents of the manufactured tea above those limits of tolerance likely to be accepted by the various food and drug authorities.

New copper dusts

With the assistance of Messrs. Imperial Chemical Industries (India) Ltd., certain fungicidal dusts of minimum copper content and possessing high adhesive qualities were formulated and a series of small-scale field trials were started early in 1950 to investigate their fungicidal values and the effects of the treatments on the copper contents and quality of the made teas.

The first phase of these experiments is now over and, while it would be premature to make any definite claims, results are sufficiently encouraging to make further investigations worth while. It is established that certain of the dusts can be applied to tea in bearing under certain conditions without affecting the quality of the tea or creating a toxic hazard and by these means a high degree of disease control appears possible.

Much work remains to be done and further experiments are planned both in Southern India and Ceylon, but the indications are that in dusting there is a technique of disease control which would seem to possess those qualities of ease, efficiency and economy so urgently needed by the tea industry in Ceylon, Indonesia and Southern India.

Home Produced Toxaphene

Since last October the insecticide *Toxaphene* has been manufactured in England by the Cocker Chemical Co. Ltd., at Oswaldtwistle, for the Hercules Powder Co., Wilmington, Delaware, U.S.A.

As described in the '*Manufacturing Chemist*' (Jan. 1951, pp. 28-29) the development of *Toxaphene* originated from Hercules' interest in the stumps of the southern U.S. pine, from which turpentine had been extracted for many years. The insecticidal properties of the extraction products were tested. From the terpene radicle many different compounds of varying insecticidal activity were found, and the next job was to find out which had the best insecticidal properties without accompanying properties that could hinder its commercial acceptance. *Toxaphene* is made by chlorinating camphene to a chlorine content of from 67 to 69%. Camphene is made by isomerising alpha - pinene, a major constituent of turpentine.

The Coconut Coir Industry in Ceylon

JOHN HUDSON, M.A.

Coir is among the many important products of the coconut industry, and Ceylon is one of the major centres of production. The author of this article recently visited that island, and this account is based upon personal observations made on the spot. For an account of other aspects of the Ceylon coconut industry readers should refer to the article by Dr. R. C. Childs in the March 1950 issue of WORLD CROPS.

THE coconut is the fruit of the palm *Cocos nucifera* and it is grown in practically all tropical countries; Ceylon is one of the major producers. It has been estimated that Ceylon accounts for 13.7% of the total world acreage and 11.6% of the annual world production of coconuts.

The fruit wall of the coconut consists of three distinct layers, a smooth outer exocarp, a fibrous mesocarp and a hard endocarp. The two outer layers are usually referred to as the husk and the endocarp is familiar as the shell of the coconut. Immediately underlying the endocarp there is a brown protective skin surrounding the kernel, which consists of the endosperm or stored food and the embryo. There is a space within the endosperm which is frequently filled with a fluid known locally as coconut water and elsewhere as ' milk.' The husk of the coconut plays a protective role in that it prevents damage when the ripe fruit falls to the ground and aids in its dispersal by its buoyancy which permits it to float on water. The exocarp is more or less waterproof and thus keeps the fruit dry and prevents premature germination.

The coconut is the source of many products. The husk after processing by the appropriate method gives rise to bristle fibre, mattress fibre, coir yarn, rope, twine, mats, matting and other coir manufactures. The shells of the nuts are a source of charcoal. The kernel is very important as food; it is often exported complete with the shell, but generally the kernel is converted to copra by drying either in the sun or in kilns. Copra is the source of coconut oil and oil cake, known locally as Poonac.

Ceylon women engaged in picking pith and stalks from dried bristle fibre

Development of the nut from the flower covers a period of approximately 12 months, and nut picking is carried out throughout the year. The average yield of a tree per year is 75 to 100 nuts.

Coconut coir

Coir production has long been an important industry in Ceylon; the product was first exported when the island was ruled by the Dutch. Before 1939 exports of coir products averaged annually about 30,000 tons of mattress fibre, 10,000 tons of bristle fibre and 5,000 tons of coir yarn. During the 1939-45 war exports declined greatly, but since the war they have recovered and by 1948 those of mattress fibre had reached pre-war level.*

In what follows the process of coir production as practised in Ceylon is described.

Husking

This process involves the removal of the husks from the rest of the coconut. The majority of the fibre millers buy husks direct from the coconut estates, but as some are also interested in other products of the coconut they buy the complete fruit and remove the husks at their mills.

Husking is carried out by means of a vertical spike embedded in a solid base. Normal rate is 2,000 nuts during a working day of eight hours. The nuts should be as dry as possible as this facilitates splitting and removal.

Retting

This consists essentially of soaking the husks in water to soften them so that the fibrous and the inter-connective tissues can be separated. The exocarp is more or less waterproof and this tends to retard the soaking process. The larger and more modern mills have installed special crushing machinery consisting of a chute leading into a pair of rotating fluted iron rollers set just wide enough apart to grip the husk and so crack the exocarp without seriously damaging the fibrous matter. As a result of this treatment the retting time is considerably reduced.

* 'The Coconut Industry of Ceylon' by R. Childs, Ph.D., F.R.I.C., WORLD CROPS, Vol. II, p. 102.

There appears to have been little scientific investigation into the retting methods used in Ceylon, but certain fundamental principles based on information obtained from scientific sources are followed in the larger and more modern small mills.

It has apparently been established that the disintegration of the tissues during retting is brought about by the action of certain micro-organisms present in the husks. This activity is only possible in water, and the condition of the water, and in particular its suitability to the action of these organisms, determines to a very large extent the effectiveness and period required for retting. Temperature of the water plays an important part since cold water tends to retard the activity of the micro-organisms, thus retting is normally quicker during the warmer months.

Frequent changes of water are desirable to prevent the poisoning of the micro-organisms by waste products resulting from their own activities, and running water is the ideal answer to this part of the problem, but it is rarely available. A complete change of water by draining or pumping is to be avoided, as this results in the removal of a large number of the micro-organisms, and would cause a temporary, but considerable, reduction in the rate of disintegration.

It is interesting to note that these organisms are active in saline as well as fresh water; the salt, in fact, has the advantage of preventing excessive fermentation and discoloration, both of which lower the quality of the fibre. When retting is carried out in saline backwaters, tidal action removes the deleterious matter from the vicinity of the husks, and the resulting fibre is stronger and a better colour than that retted in stagnant water.

It is generally recognised that retting is quicker in fresh water but less complete and that, therefore, more pith remains associated with the fibre. The explanation lies in the fact that the husks are more buoyant in the salt water and are more difficult to submerge completely, and this tends to retard retting.

The quality and yield of the fibre are also controlled by the type and condition of the husks; thus short husks cannot produce long fibre and old husks have usually been excessively dried and bleached so that the resulting fibre is brittle and discoloured.

In Ceylon retting is carried out in almost any place where stagnant water is available, such as ponds, depressions in the ground, at a river's edge, but most commonly in specially dug pits and in the more modern mills in well-built concrete tanks. There is some retting in brackish water, but as far as bristle and mattress fibre is concerned it is confined to the Negombo lagoon and certain small brackish rivers and canals in this area. The retting of husks used for the production of coir yarn is carried out entirely in salt water, and this industry is more or less confined to Galle and surrounding district, and is quite separate from the mattress and bristle trade.

Use of tanks and pits

Concrete retting tanks are expensive and therefore comparatively rare, but they offer certain definite advantages over pits, both as regards retting efficiency and the quality of the product. They are usually built as a series of small units each measuring approximately 27 ft. by 9 ft. and about 6 ft. deep. Their construction permits frequent changing of the water which is free from mud, and thus a superior quality fibre should result. Large concrete tanks about 25 yd. square are also found. The total capacity of the tanks at the large mills is 200,000 crushed husks, or 140,000 normal husks.

Pits vary in size and shape; at the average mill there are two each approximately 25 yd. square with a capacity ranging between 100,000 to 200,000 husks.

There are larger pits with a capacity of up to one million husks, but these are rare and only occur at the large mills. Retting efficiency of pits depends to some extent on the quantity of husks, since there is no means of applying pressure to ensure the complete submersion of the husks, except that provided by the husks themselves. In the case of tanks pressure is supplied by means of girders fixed firmly in the walls of the tanks just below the water level, or in some cases by means of heavy logs placed on top of the husks and held in position by chains.

One big advantage of the tank over the pit is the time taken for retting. In tanks, retting of husks previously crushed is complete in three to seven days and, if the husks have not had prior treatment, in seven to ten days. In the pits the period is much longer, ranging between three to six weeks according to the position of the husks in the pit, those which are completely submerged requiring a shorter period than those on the surface.

Fibre retted in tanks is better in colour than that retted in pits, except when the latter have sand or gravel bottoms. It is possible for over-retting to occur, especially when, due to shortage of work, the mills close down. The fibre obtained from these husks is poor in colour and lacks strength.

Retting with the aid of chemicals is used in parts of India where several processes are in operation, but these have not yet been employed in Ceylon. The chief advantages claimed for them are that they require less time and give a better yield and a greater consistency in the quality of the fibre.

The retted husks are removed from the retting pits and tanks by boys who enter the water and throw out the husks which they consider are ready for the drums. In large tanks and pits a lane is marked out by bamboo canes and this area is completely cleared. The top husks which require further retting are thrown into the part of the pit just previously cleared. In the small tanks one unit is completely emptied at one time and the few husks which require further retting are thrown into an adjacent tank which is in the process of being refilled.

The retted husks are carried from the pits to the drums; in large mills bullock carts are used, while in one case trucks on a railed track carry out this function.

Decortication or milling

This involves the separation of fibre from connective tissues of the husks and is carried out by means of specially constructed machines called drums. They are arranged in pairs, one is called the breaker drum and the other the cleaning drum. Each consists of a wooden wheel 3 ft. long in diameter with treads about 1 ft. wide and 6 in. long, into which have been bolted iron nails placed 1½ to 2 in. apart, giving a total of approximately 30 nails per tread. There are 1,200 nails on the crushing drum and 1,350 on the cleaning drum. The drums revolve at a high speed, driven by a belt from a shaft which derives its power from a Diesel engine.

The major part of the wheel is enclosed in a wooden guard, but there is an opening about 1 ft. wide protected by a pair of rotating iron bars, the ends of which lie in grooves, which permit the upper bar to move up and down. This arrangement facilitates feeding and provides protection for the hands of the operator. The lower part of the covering of the wheel takes the form of a chute which delivers material, removed by the nails on the wheel on to the ground below and well clear of the drum. Nails on the drums are subject to wear and tear and are normally replaced at least once every two months as worn nails tend to split and damage the bristle fibre.

Operators must be experienced and skilful if the best quality fibre is to be obtained and excessive waste avoided. The operator in charge of the breaker drum

A series of concrete retting tanks. The mound in the background consists of dust, pith and foreign matter removed from the mattress fibre during the sifting process

has the more difficult task. He holds one end of a piece of husk and forces the other end between the two iron bars so that the exocarp surface is pressed against the nailed surface of the rotating wheel. The nails tear away the exocarp, short fibres and connective tissue leaving the longer fibres. The operator then withdraws the husk and reverses it, repeating his previous performance so that eventually only the long fibres and some pith remain in his hands.

He places this fibre on a special ledge between himself and his fellow operator on the cleaning drum. This operator then takes three or four of these bundles of fibre and subjects them to a further cleaning treatment following the same procedure as before, pressing first one end and then the other against the finer nails on the cleaning drum. The fibre left in his hands is bristle fibre and the majority of it must be at least 8 in. in length, otherwise it cannot be classified as such. About 5% of the pieces of husk bought by the miller are below 8 in. long and these are used to supplement the mattress fibre.

The fibrous material removed by the breaker drum is subjected to a further cleaning process and is classified as mattress fibre. The fibre extracted by the cleaning drum is long in staple and usually more free from pith than the mattress fibre; it is commonly called Mill O'Mat and is used by the miller for making the coir twine which is tied round the ballots of mattress fibre and bundles of bristle fibre produced at the mill.

It is generally accepted that one pair of drums can handle 2,000 husks during the course of a working day of eight hours, and the production from these should be 2 cwt. of bristle fibre and 4 cwt. of mattress fibre, provided the husks are of a good quality. Small mills have three or four pairs of drums and the daily output is 12-16 cwt. of mattress fibre and 6-8 cwt. of bristle fibre. Larger mills have five to six pairs of drums, but up to 25 pairs are used in some mills.

Cleaning, drying and packing bristle and mattress fibre

Bristle fibre is conveyed by hand to a washing shed where it is rinsed by women in clean fresh water contained in a concrete bath about 12 ft. long, 4 ft. wide and 18 in. deep; this removes much of the mud and pith adhering to the fibre. Small bunches of washed fibre are then spread out fanwise on the ground for drying which is normally completed in about eight hours. The dried fibre is then collected and taken to the hackling shed.

Hackling is carried out by women and consists of combing the dried bristle fibre by drawing it through a set of steel spikes usually eight in number, each about 6 in. high, 1 in. apart, and fixed vertically. This removes a further quantity of pith and the shorter fibres, the resulting product is called rough hackled bristle fibre. It is tied into hanks each weighing about 1 lb.; 25 to 30 hanks tied together make a bundle ready for transport to the shippers' stores.

Many of the smaller mills do not hackle their bristle fibre and it is offered to the shippers as unhackled one-tie bristle fibre which is the lowest grade in the trade.

Mattress fibre

The fibrous material, pith and hard pieces of exocarp removed by the crushing drum are carried by boys to a rotating cone-shaped sifting machine of stout wire netting with a mesh of about 1½ in., rotating at a speed which causes the fibres and other materials put in the narrow end to be subjected to a rough sieving action as they pass along the cone. Some short fibres, much of the pithy matter and mud particles are removed and collect underneath this machine while the sifted fibre is discharged from the wide end of the cone.

It is usual to put the short fibres and pith through the sifter a second time before it is removed. The fibre, after sifting, is spread out on the ground to a depth of 1 ft. to 18 in. to dry. In fine sunny weather this is completed in about eight hours and the dried fibre is then taken to the baling shed. To ensure that the fibre is properly dried it is turned two or three times during drying by small boys who flick the fibre by means of a forked stick.

The millers have no means, other than the sun, of drying fibre and no covered accommodation for the storage of fibre during periods of rain. They have great difficulty in drying fibre during wet weather and as the space for drying is very limited a holdup in production may result if rain is abnormally frequent.

In the baling shed the fibre is packed by hand-operated presses into small bales known as ballots, each containing approximately 11 lb. of fibre. These presses consist essentially of two containers between which is an enclosed wooden ram used to compress the fibre into ballots measuring approximately 2 ft. long by 14 in. by 7 in. The ram is moved on a ratchet by means of handles on each side of the press, on

which the packer swings with his hands and feet to exert the necessary pressure. Three boys are usually employed to pack the fibre, one supplies the material while the other two, working on opposite sides of the press, fill the box and move the ram into position in turns. The compressed fibre is tied with coir twine, passed through slots in the sides of the baling box, and then round the bale with the aid of a large needle. The ballot is now ready for delivery to the shippers' stores.

The shippers' stores : bristle fibre

Bristle fibre is weighed on arrival and samples are drawn from the bulk delivery for examination, as a result of which the fibre is graded and a price fixed. Grading points are length, stiffness and colour. The lowest quality usually receives no further attention except bleaching. The better qualities after storage to ensure complete dryness are hackled in the same way as at the mills, but with a greater thoroughness, an oily liquid, chiefly coconut oil, being used on the hackling pins.

The fibre is then graded as regards length and converted into hanks each weighing about 1 lb. and tied by three, two or one twisted fibre cords, according to grade. This fibre is then bleached to obtain a more even colour. Bleaching is carried out in sealed rooms with slatted floors under which run tunnels in which pans containing burning sulphur are placed; the sulphur dioxide bleaches the fibre. Bleaching occupies approximately 24 hours, and the bristle fibre should then be a uniform golden colour. Two other processes are carried out on occasions at the shippers' stores, namely, dyeing and drafting.

The dye, normally black in colour, is contained in large metal vats with open tops. The fibre is introduced into the dye in a cage lowered into the vat by a pulley. After being withdrawn from the vat the fibre is left in the cage to drain and then dried in special ovens.

Drafting is really a form of super-hackling and grading according to fibre length. The resulting banks are cut to a given length and the product is ready for a immediate use.

The hanks of bristle fibre are baled under pressure and the baling box is lined with hessian so that the resulting bale is completely protected. The baling presses are of the hydraulic ram type, but the pressure is closely controlled as excessive compression damages the fibre. The recognised market grades for unbleached bristle fibre are three tie, the longest and best quality; two tie, average in length and quality; one tie, rather below average in length and quality; and one tie unhackled, which is variable.

A sifter, viewed from the end at which sifted mattress fibre is collected

The husking process. Normal rate is 2,000 nuts during an eight-hour day

Mattress fibre

The ballots are weighed and a few samples drawn for inspection. The fibre is graded; this is done usually during the early part of the morning when all that day's deliveries have been made.

Grading is based on colour, fibre length, resilience and general cleanliness, especially the quantity of pith present. Three classes are generally recognised: No. 1 the best quality, Fair Average Quality explains itself, and No. 2 which is of average quality but grey rather than brown in colour.

After grading the fibre is stacked in storage sheds, in ballot form, up to a height of 30-40 ft. The fibre remains in store for at least three weeks before it is baled prior to shipment. The shipper prefers to bale fibre with a moisture content of between 12 and 14%.

The shippers usually have cleaning plant available, and this is used before the fibre is baled if necessary. Cleaning necessitates breaking up the fibre ballots and results in baling the fibre in its loose form. After cleaning the fibre is weighed out in hundredweights and transferred to the baling shed. The ballots are sent direct from the stores and the coir twine removed before packing, but no weighing is necessary and filling in is done with the aid of a supply of loose fibre. In some cases ballots are opened and teased out by hand before the fibre is packed into the baling box.

Baling presses vary in design, but the principle involved in each case is that of a hydraulic ram and there are normally two baling boxes. The older type of press has baling boxes which are filled by hand and the fibre is pressed into space by a boy standing in the box and stamping down the material with his feet. Ballots are often used for this type of baling as they are already compressed to some extent. The new type of baling press is fitted with a rammer which operates from above the box and is more effective in compressing the fibre, particularly during the initial stages.

When full, the baling box is swung into position above the hydraulic ram and the reserve box is then ready for filling. The ram is brought into action; the doors of the baling box are opened, and the hessian squares placed in position. The baling iron is tightened round the bale with a special grip, which has a long handle for leverage purposes. The iron is held in position by wooden chucks until it is eventually tied and the pressure released.

The 3-cwt. bale which is the one now generally supplied varies in capacity from 10 to 12 cu. ft. Mattress fibre can still be obtained in the twisted rope form, but the demand for this material is very small. It is claimed that the product is more resilient than the material in baled form.

Organisation and industrial relationships

There are a large number of fibre mills in Ceylon, the majority being situated in the Negombo area. The mills, with the exception of a few which are owned by large trading companies, are controlled by the Ceylonese farmers and smallholders.

The Specific and Selective Action of Insecticides

'INSECTICIDES and their study' was the title of the second Fernhurst lecture delivered before the Royal Society of Arts on January 10 by Dr. C. Potter, Head of the Department of Insecticides and Fungicides at Rothamsted Experimental Station, with Professor T. Wallace, O.B.E., Director of Long Ashton Experimental Station, presiding.

We may remind our readers that these lectures have been endowed by Plant Protection Ltd. and are delivered annually; they are devoted to reviews of recent advances in the scientific control of pests, diseases and other enemies of crops. The first lecture was given last year by Professor Blackman and dealt with selective weed control by the new hormone weedkillers; it was reported in this Journal, Vol. 2, page 252.

The present lecture dealt particularly with the chlorinated hydrocarbons and the organo-phosphorous compounds, which have attained so much prominence as insecticides of recent years, and with their mode of action. It further considered the specific and selective action of particular insecticides for particular species and groups of insects and discussed the principles involved.

In his opening section Dr. Potter listed the chemical nature of the most important of the new synthetic organic insecticides. They included the following.

Chlorinated hydrocarbons

DDT (2, 2-bis-(p-chlorphenyl)-1, 1, 1-trichlorethane). DDT can act both as a stomach and contact poison; it does not damage plants in the concentrations normally employed, with the exception of the *Cucurbitaceae* (*e.g.* marrows and cucumbers), and can be used to control insects belonging to most of the natural orders except the *Rynchota*, which include scale insects and aphids. The fluorine analogue of DDT is claimed by German workers to have a quicker action. The methoxy, dichlor and bromine analogues have also been used with success.

Benzene Hexachloride. The insecticidally active constituent of this material is the gamma isomer of 1, 2, 3, 4, 5, 6-hexachlorocyclohexane. More volatile than DDT, it can be used as a fumigant under some circumstances. It is toxic to many insect species and is principally used against soil pests, grasshoppers and locusts.

Chlordane is used mainly in the U.S.A.; it contains 60% chlordane and 40% related hydrocarbons. It is a stomach and contact poison and fumigant, and can have a lasting residual action. It appears to be particularly valuable for the control of grasshoppers and also shows promise against soil pests and those of market gardens, forage crops and cotton.

Toxaphene is a chlorinated camphene, containing about 67% chlorine; its chemical structure is still under investigation. It is a cream-coloured waxy solid, insoluble in water and appears likely to have good residual properties. It has been used extensively abroad, particularly for controlling cotton pests. It has not yet been employed to any extent in the United Kingdom.

Aldrin and **Dieldrin** are two other chlorinated hydrocarbons at present being investigated. The former is volatile, having no long-lasting residual properties, while the latter is stable and can retain its insecticidal potency for long periods after application.

They are both very stable to the action of alkaline reagents in aqueous and alcoholic media, and Dieldrin compares with DDT in residual effects. A limiting factor to the use of these two compounds is that they appear to be considerably more poisonous to mammals than the other chlorinated hydrocarbons, although they are toxic to a wide range of insect species.

Organo-phosphorus compounds

HETP and **TEPP** (hexaethyl tetraphosphate and tetraethyl pyrophosphate). Tetraethyl pyrophosphate is the active ingredient in both cases and the name depends on its percentage in the concentrated product, materials with a low percentage being called HETP. TEPP has no lasting residual properties as it hydrolyses to phosphates in the presence of water. It is effective against various species of aphids but, in common with all organo-phosphorus compounds, is poisonous to mammals.

Parathion (o.o.-diethyl-o.p.-nitrophenyl thiophosphate). This material is only slightly soluble in water, so it may have lasting residual properties. Besides being toxic to a wide range of insects it is also toxic to mites and has ovicidal

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The Coconut Coir Industry in Ceylon—*Conclusion*

Some own the site and the equipment, others own the machinery and rent the land, while some rent the complete mill. The millers have organised the 'All Ceylon Millers' Association,' a trade organisation responsible for safeguarding the interests of millers particularly in relation to market prices.

The majority of the work is carried out on a contract basis which offers advantages as little capital is involved, and does not incur the problem of storing large stocks. It does entail, however, that the mills are often closed down completely for long periods, particularly the small mill.

The miller deals with the shipper either directly or through the shippers' internal broker, or through a free broker. The brokers are responsible for arranging the majority of the contract work. Spot sales are not uncommon and are generally carried out directly between the miller and the shipper.

During 1948 the Ceylon government set up a committee on which the interests of the millers, brokers and shippers were represented. The chief aim was to establish a minimum price, known as the 'fair price,' to be paid to the miller by the shipper for both bristle and mattress fibre.

This has to be related to two factors, the price of husks of a suitable quality and the market demand for fibre. In view of the fact that several variables, such as the weather, international politics and post-war shortages, have a direct bearing on these factors, it was decided that the committee should meet from time to time to review the situation in the light of conditions ruling. As a result the 'fair price' has been revised on at least two occasions since its introduction to meet changes in conditions.

ACKNOWLEDGMENTS

The author desires to express his appreciation to the directors of Lintafelt Ltd. for making the visit to Ceylon possible and for permission to publish this information and use the illustrations which have been taken from the cine film made during this visit. He is also very grateful to Mr. Nadarajah of the Ceylon Government Department of Commerce, and the unnamed millers, brokers, and shippers for all their kindness, help and information so readily supplied during the course of the visit.

The illustration on page 107 is by courtesy of Messrs. Volkart Brothers (Colombo). The other illustrations are from the cine film taken by Mr. Hudson.

(*Reproduced in abbreviated form from our sister journal* FIBRES.)

properties; it is, however, highly toxic to mammals.

Bis-(Bis-Dimethylamino) Phosphonous Anhydride. Experimental work on organo-phosphorus compounds showed that some when applied to aerial parts or roots of plants are taken up and translocated to other parts of the plant. This systemic action had already been exploited, using selenium compounds, but the work on phosphorus compounds led to increased interest and this compound is now being used commercially for the control of aphids. The compound has high mammalian toxicity and must be used with caution.

Allethrin. Cinerin 1 is one of the four recognised active constituents of pyrethrum flowers and Allethrin is the synthesised allyl analogue of Cinerin 1. It appears to have some of the desirable properties of the pyrethrins, especially their lack of toxicity to mammals.

Toxic dangers

Having surveyed the principle new insecticides now in use, Dr. Potter went on to discuss some of their advantages and disadvantages. With the exception of Allethrin they are all more or less toxic to humans, and although they can usually be handled safely it is still undesirable to have to use dangerous chemicals at all. In any event, high mammalian toxicity limits an insecticide's use, particularly on fruit and vegetables. In this respect the introduction of Allethrin is important.

The problems of specific action

The effect of an insecticide on different species of insects and on the different life-stages of the same insect may vary considerably and this factor of specificity is a very important one when defining the properties of any material. As an example, to quote from the paper, if rotenone, one of the insecticidally active constituents of Derris, is applied in aqueous suspension to various species of aphids, it is found to be highly toxic; on the other hand, if it is applied in a similar suspension and under similar conditions to grain weevil, *Sitophilus granarius*, it is non-toxic at very high concentrations. This type of specificity may be referred to as species-specificity.

In the development work carried out on new insecticides very little is known of the process that determines the result (*i.e.* whether the insect lives or dies), and in order that the mechanism of the action on the insect may be worked out the close integration of the chemical and biological aspects of the work are of the greatest importance. The work of Wigglesworth and his collaborators on the structure and function of the insect cuticle which enabled them to account for the action of abrasive dusts is an example of the value of an adequate biological background.

Dr. Potter mentioned some of the practical problems which are at present handicapping progress on account of lack of knowledge about specificity. He emphasised the importance of comparing specificity of effect of different insecticides; this is not an easy task, since effectiveness will vary between different insect subjects. As an example, he quoted the work of Lord at Rothamsted, who prepared the other halogen analogues of DDT, and tested them on two insect species. He found that the order of toxicity of the analogues varied with the species of insect. Thus on *Macrosiphoniella sauborni* it was chlorine analogue>fluorine analogue >bromine analogue, while on *Oryzaephilus surinamensis* the order was chlorine analogue >bromine analogue>fluorine analogue.

From this type of experiment it is impossible to generalise while so much information is still lacking on the relationships between chemical structure, physical properties and physiological effect. Dr. Potter considered that the tendency among organic chemists to ignore specific effects and to consider that there is such a thing as a standard representative test insect is a dangerous misconception.

Effect on field population

No insecticide is so specific that it will kill only one plant pest and not harm other species of insects. The most likely to be affected are the parasites and predators of the pest itself; if these are destroyed there may be a rapid build-up of the pest again after treatment, necessitating further control measures. This may result in the dilemma that if an insecticide is used, subsequent rapid population build-up may necessitate further treatment and if it is not used the crop may be destroyed.

Another difficulty is that insecticide applications may destroy one pest only to make way for another. For example, DDT will control codling moth on fruit trees, but if applications are continued outbreaks of red spider quite frequently occur because DDT destroys not only the codling moth but also parasites and predators of the red spider, while the latter is specifically resistant to DDT. Similarly, some insecticides are highly poisonous to bees and their application may result in serious damage to the crop through lack of pollination. DDT and toxaphene appear to be relatively harmless to foraging bees in this respect.

Resistant strains

Another major problem is the evolution of strains of insects which become resistant to insecticides as the result of repeated applications. Many examples of this have occurred during the past 40 years, instances being strains of the San Jose scale resistant to lime sulphur, of codling moth resistant to arsenicals and citrus scale insects resistant to hydrogen cyanide. With the introduction of the modern synthetics many instances of resistant strains have been reported: in some cases a chemical at first effective has become useless on this account. Obviously a study of the factors involved in producing resistant strains is of paramount importance. At present not only is the mechanism of their evolution largely a matter of speculation, but the basis of resistance is not known with certainty.

Conclusion

Dr. Potter concluded that if research is directed along right lines and the knowledge acquired applied in practice, chemicals will play an increasingly useful part in the control of harmful insects. His final words were: ' I conceive of the study of insecticides as a search for precision weapons to destroy selectively harmful insects, and specificity, while it prevents many difficulties, is in fact the basis of that selectivity.'

New Control for Corn Pests

A demonstration of a new control over insects infesting stored corn was given in Georgia, U.S.A., when Dr. Walter E. Dove, Director of Entomological Research for U.S. Industrial Chemicals, Inc., and former Head of the Division of Insects Affecting Man and Animals, U.S.D.A., showed that the new protectant had kept shelled, husked and unhusked corn (maize) free from insects. Its use, Dr. Dove said, was not confined to corn, but could be effectively applied to rice, barley and other grains. The insecticidal ingredients used are a combination of piperonyl butoxide and pyrethrins, which, together with a carrier, are mixed with the corn. The product is called Pyrenone grain protectant, and was investigated for three years before being produced for consumer use. It is claimed to be free of toxicological hazards to humans and warm-blooded animals and gives protection to stored shelled corn for ten months.

A Review of Italian Crops—1950

This land in Tuscany was once a marsh. Reclaimed, it is now a fertile valley

THE PRINCIPAL CROPS IN ITALY (in thousands of tons)

	Pre-war Average (1936-39)	1947	1948	1949	1950	% *Difference compared with* 1949	*Pre-war*
Cereals :							
Wheat	7,550.8	4,679.4	6,144.4	6,940.4	7,563	+ 8.97	+ 0.16
Rye	138.5	97.1	112	125.3	130.5	+ 4.15	— 5.78
Barley	221.5	179.1	230.4	226.7	290.9	+ 28.32	+ 31.33
Oats	566.1	446.7	485.7	414.7	553.4	+ 33.45	— 12.23
Rice	776.1	635.5	618.8	590.9	650	+ 10	— 16.25
Maize	2,960.2	1,923.5	2,249.8	2,202.4	2,000	— 9.19	— 32.44
Beans (dry) ..	634.9	291.4	332.5	262.3	486.5	+ 85.47	— 23.37
Haricot beans ..	162.2	131.5	159.8	126.3	170.3	+ 34.84	+ 4.99
Peas	18	12	11	10.8	12.4	+ 20.39	— 31.11
Chick-peas ..	39.3	48	52	49.8	54.5	+ 9.44	+ 38.68
Lentils	12.8	11.6	12.3	10.9	12.2	+ 30.28	+ 10.94
Potatoes	2,716.5	2,806.4	3,010.7	2,612.2	2,533	— 3,03	— 6.76
Beans (fresh) ..	89.6	92.5	111.3	95.7	134.7	+ 40.75	+ 50.33
Haricot beans (fresh)	49.3	67.2	77.0	71	76.1	+ 6.88	+ 54.36
Peas (fresh) ..	80.5	97.1	105.5	78.5	124.9	+ 59.11	+ 55.16
Tomatoes ..	952.3	994	965.8	1,075.3	1,294.6	+ 20.39	+ 35.94
Asparagus ..	11.5	9.1	11.9	10.9	12	+ 10.09	+ 4.35
Artichokes ..	76.4	84	109.7	97.8	136.6	+ 39.67	+ 78.8
Cardoons, fennel and celery ..	127.6	142.3	145	159	160.5	+ 0.94	+ 25.78
Cabbage	459.4	546	566.3	606.5	609.7	+ 0.53	+ 32.72
Cauliflower ..	269.8	421.6	410.8	443.7	443.1	— 0.14	+ 64.23
Onions and garlic	149	211.3	250.8	211.3	221	+ 4.78	+ 48.59
Melons and water-melons	397.4	384.1	371.2	353.4	337.1	— 4.61	— 15.24
Tobacco	42.5	76.4	74.4	71.8	73.5	+ 2.37	+ 72.94
Sugar-beet ..	3,271.6	2,229.8	3,408.6	3,451.2	3,527.9	+ 2.22	+ 7.83
Hemp (stalks) ..	109.7	61.2	76.8	72.2	60.4	— 16.34	— 44.94
Hemp (seeds) ..	3.4	2.7	2.5	3.1	2.7	— 12.9	— 20.59
Flax	3.8	4.8	5.7	5.6	6.2	+ 10.71	+ 63.16
Linseed	5.9	11.5	12	11.5	9.3	— 19.13	+ 57.63
Cotton (fibres) ..	5.3	3.3	2.6	1.8	3.3	+ 83.33	— 37.74
Cotton seeds ..	10.2	5.2	4	2.9	4.6	+ 58.62	— 54.90
Oilseeds	9.1	48.2	41.5	28.4	26.8	— 5.63	+194.51
Grapes	6,158.6	5,341.9	5,790.8	5,905.9	5,798	— 1.83	— 5.86
Olives	1,426.3	1,550	636.2	1,089.7	868.1	— 20.34	— 39.14
Oranges	325.5	330	353.4	262	397.9	+ 51.41	+ 22.24
Mandarins ..	53.4	54	56.6	49.9	60.9	+ 22.04	+ 14.04
Lemons	326.9	280.5	254.6	233.3	238.4	+ 2.19	— 27.07
Apples	288.3	483.5	378.4	673.2	517.8	— 23.08	+ 79.6
Pears	197.1	252.9	211.3	337.7	296.4	— 12.23	+ 50.38
Peaches	231.3	234.1	191	231.6	283.2	+ 22.28	+ 22.44
Apricots	25.2	13.6	18.3	19.7	27.3	+ 38.58	+ 8.33
Cherries	66.8	102.2	78.3	101.3	104.4	+ 3.06	+ 56.29
Plums	51.6	65.7	61.8	80.2	91.3	+ 13.84	+ 76.94
Almonds (unhusked)	180.4	163.3	96.3	70.8	219.3	+209.75	+ 21.56
Hazel nuts (unhusked) ..	21.8	13	21.2	27.5	31.5	+ 14.55	+ 44.50
Walnuts	48	49.4	44.1	48.5	45.1	— 7.01	— 6.04
Mulberry leaves ..	977.3	1,172.6	1,127.7	1,095.2	1,008.9	— 7.88	+ 3.23

ITALIAN agricultural statistics for 1950 have now been made available and the following is a general review of the crop position in that country, based on material supplied by our Italian correspondent.

One important factor of last year was that Italian farmers were using more chemical fertilisers. Statistical records show that during the first half of 1950 compared with the same period in 1949, 11% more superphosphate, 23½% more potash fertilisers and 17% more bi-ammonium phosphates were used. And in two years consumption of phosphates has gone up 63.2%, nitrates 56%, potassic fertilisers 52% and compounds 279%.

Apart from a certain amount of drought, the weather in 1950 was favourable to farmers and, generally speaking, yields were higher than in 1949 and also, in many cases, than before the war (1939).

Areas

Cereal crops in 1950 occupied 6,904,000 hectares (one hectare=2.47 acres), slightly less than the 6,911,000 hectares devoted to cereals in the previous year and about 93% of the area under cereals before the war. **Barley** and **oats** areas increased by 29.2% and 9.7% respectively compared with the pre-war average while **maize, wheat, rice** and **rye** decreased by 15.6%, 7.8%, 6.7% and 3.9% respectively. These last being cereals needed for human food, the decrease is all the more unexpected, particularly as Italy's population has increased by about 4,000,000 since the war.

The areas under vegetable crops increased, with the exception of potatoes, which registered a slight decline. Compared with the pre-war averages, the areas under **onions** and **garlic** have increased by

67%, **cardoons, fennel** and **celery** by 57%, **cauliflower** by 54% and **tomatoes** by 49%.

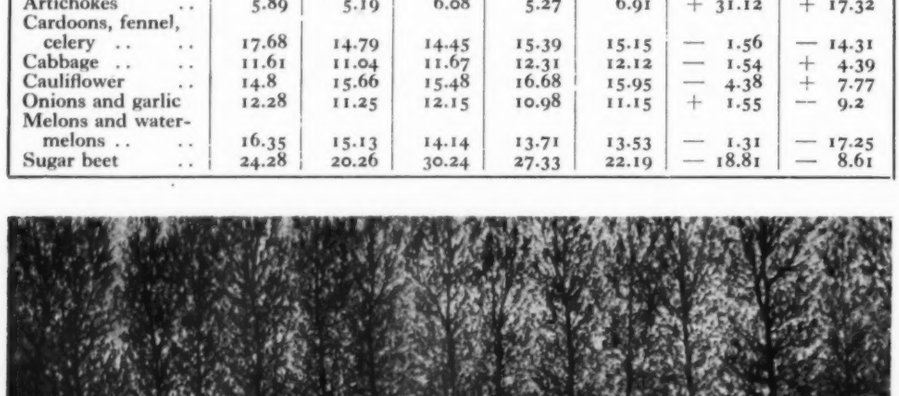
The **sugar beet** area of 159,000 hectares was nearly 18% greater than before the war and slight increases were also registered by **tobacco** and **cotton. Flax, oilseeds** and **hemp** were considerably reduced in area.

Production

Cereal production increased for all cereals except **maize,** which dropped by slightly over 9%, a decline which is accounted for by the smaller area and unfavourable weather for the crop. **Wheat** production increased 9% in spite of the fact that the area was reduced. The same applies to **rye** (production increased by 4.15%) and **barley** (production increased by 28.32%), whose diminished areas were more than counterbalanced by improved yields per hectare. Output of **oats** was still slightly below pre-war, but a substantial improvement (33.34%) had taken place since 1949. **Rice** production is still considerably below the pre-war level (16.25%), but in 1950 a substantial improvement over 1949 was obtained. Yield per hectare was 4.69 tons, which is well below the pre-war figure of 5.22 tons per hectare.

YIELDS PER HECTARE OF THE PRINCIPAL CROPS IN ITALY (in metric tons)

	Pre-war (1936-39)	1947	1948	1949	1950	% *Difference Compared with* 1949	% *Difference Compared with pre-war*
Wheat	1.48	1.04	1.32	1.47	1.6	+ 8.84	+ 8.11
Rye	1.35	0.99	1.13	1.26	1.33	+ 5.56	— 1.48
Barley	1.15	0.74	0.92	0.91	1.17	+ 28.57	+ 1.74
Oats	1.31	0.93	1.02	0.89	1.17	+ 31.46	— 10.69
Rice	5.22	4.82	4.34	4.48	4.69	+ 4.69	— 10.15
Maize	2.03	1.56	1.81	1.78	1.63	— 8.43	— 19.7
Beans (dry)	0.97	0.61	0.63	0.5	0.9	+ 80	— 7.22
Haricot beans	0.33	0.26	0.32	0.25	0.35	+ 40	+ 6.06
Peas	0.76	0.63	0.6	0.56	0.68	+ 21.43	— 10.53
Chick peas	0.39	0.44	0.47	0.45	0.49	+ 8.89	+ 25.64
Lentils	0.59	0.47	0.49	0.43	0.53	+ 23.26	— 10.17
Potatoes	6.07	6.76	7.41	6.7	6.65	— 0.75	— 1.63
Beans (fresh)	4.85	4.23	4.91	4.08	5.54	+ 35.78	+ 14.23
Haricot beans (fresh)	1.36	1.64	1.9	1.74	1.84	+ 5.75	+ 35.29
Peas (fresh)	3.27	3.24	3.42	2.44	3.64	+ 49.18	+ 11.31
Tomatoes	16.73	13.81	14.2	14.32	15.26	+ 6.56	— 8.79
Asparagus	4.44	3.82	4.68	4.22	4.64	+ 9.95	+ 4.5
Artichokes	5.89	5.19	6.08	5.27	6.91	+ 31.12	+ 17.32
Cardoons, fennel, celery	17.68	14.79	14.45	15.39	15.15	— 1.56	— 14.31
Cabbage	11.61	11.04	11.67	12.31	12.12	— 1.54	+ 4.39
Cauliflower	14.8	15.66	15.48	16.68	15.95	— 4.38	+ 7.77
Onions and garlic	12.28	11.25	12.15	10.98	11.15	+ 1.55	— 9.2
Melons and watermelons	16.35	15.13	14.14	13.71	13.53	— 1.31	— 17.25
Sugar beet	24.28	20.26	30.24	27.33	22.19	— 18.81	— 8.61



Women working in the rice fields of the Province of Pavia laying in the valley of the Po

Apple harvest in Merano, a favourite health resort in the Dolomites

All vegetables, except **melons, water melons** and **cauliflowers,** did well and **fresh broad beans, peas, artichokes** and **tomatoes** showed great improvements in yield. The yield of **sugar beet** per hectare dropped considerably compared with the two previous years, 1948 and 1949, when yields per hectare exceeded the pre-war figure. Thus, although the **sugar beet** area had been increased by 26.19% in comparison with 1949, the output obtained registered a modest increase of 2.22%. Among the 'industrial' crops **flax** and **cotton** production increased, while **hemp, linseed** and **oilseeds** decreased.

Tree crops were, on the whole, satisfactory. It is true that **olives** registered a drop due to their biological cycle and **grape** output was inferior to that of 1949, but **citrus fruits** made up for it. Substantial improvements in ou put compared with 1949 were made by **peaches, apricots** and **almonds,** moderate improvements by **cherries, plums** and **hazel nuts,** and decreases by **apple** and **walnut** production. Compared with the pre-war years, all citrus and fruit tree crops have increased, with the exception of **lemons** and **walnuts.**

In 1950 the yields per hectare for all crops, except **maize** and **sugar beet,** exceeded or were about the same as in the previous year. In comparison with pre-war figures, **wheat, barley, chick peas, fresh broad** and **haricot beans, pea, asparagus, artichokes, cabbage** and **cauliflower** have all exceeded them; **rye** and **potatoes** have almost reached them.

Photos : E.N.I.T.

NEW BOOKS

The Agriculture of the Cultivation Steppe

By N. V. Rounce. Pp. ix + 110. Illustrated. Department of Agriculture, Tanganyika, and Longmans, Green and Co., Capetown. 1949.

This book represents an effort to describe the agriculture of the Lake, Central and Western Provinces of Tanganyika Territory. The author, Mr. N. V. Rounce, is a senior agricultural officer of the territory and he has been assisted in his task by other officers of the Department and of the Empire Cotton Growing Corporation.

The region in question is one of low to medium rainfall, 20 to 35 in.; the vegetation is dry bush, surrounded by tsetse-infested territory. It covers about 100,000 square miles and is occupied by 11 African tribes numbering 2 million people—about two-fifths of the population of the territory. Detailed accounts of the native agriculture of African territories are still by no means common and as reliable information on this subject must form the basis of efforts to improve existing conditions, the book is to be welcomed.

It is written in simple language as it is intended to help African agricultural instructors in their extension work as well as providing reliable data which can be used in schemes for development.

The early chapters survey the conditions and give concise account of the agricultural communities, types of agriculture practised, size of holdings, distribution of populations and similar matters, followed by discussions of directions in which improvements appear to be possible and certain special factors which affect the position, including soil erosion, the control of certain weeds, manuring and the use of grass as a soil improver. The rest of the book is devoted to the agriculture of specific crops, with a concluding chapter in which methods of introducing improved agricultural systems are discussed and the main points of the underlying problems and difficulties considered. An appendix describes the main soil types of the region.

The book contains numerous statistics and tables which add to its value, and is illustrated by a number of well-chosen photographs which give a clear idea of many aspects of the conditions; it is a pity, however, that many of the illustrations are very poorly reproduced since this detracts from its value.

H.T.

Advances in Agronomy II

Edited by A. G. Norman. Pp. 407. Academic Press, New York, 1950,

This volume contains the following reviews: *Cotton:* J. E. Adams *et al.*; *Soil Nitrogen:* L. E. Ensminger and R. W. Pearson; *Vegetable Production:* J. E. Knott and O. A. Lorenz; *Prairie Soils of the Upper Mississippi Valley:* G. D. Smith and W. H. Allaway and F. F. Riecken; *Ladino Clover:* G. H. Ahlgren and R. F. Fuellman; *The Control of Soil Water:* E. C. Childs and N. Collis-George; *Preservation and Storage of Forage Crops:* R. B. Musgrave and W. K. Kennedy; *The Reclamation of Coal Mine Spoils:* H. Kohnke; *Irrigated Pastures:* W. Keller and M. L. Peterson.

The Editors have urged the authors of these reviews ' to present, as far as possible, unified, complete and authoritative accounts of the recent developments in their particular fields.' To a great extent this has resulted in complete and balanced accounts which will be very useful. But, as with an animal diet, balance and completeness are only valuable if the product is palatable and digestible. It is unfortunate that the articles in most modern review journals lack the continuity of digests, partly because there is little personal critical evaluation of the material, and the result is a string of abstracts. These are still valuable as guides to the literature, but for maximal value the presentation should allow of easy reading and be in memorable form. There is a tendency for each author to belittle his own work in an attempt to be fair and balanced. Yet the literature must inevitably be regarded by an author in its relationship to his own interests—and the continuity attained by a personal treatment often makes for easier reading than a severely logical and impersonal survey.

In this volume the titles of the reviews are often a little misleading. ' Cotton ' is a collection of reviews dealing with aspects of the economics, physiology, pests, diseases and improvement of cotton, and is almost entirely confined to the U.S.A. The omission of Harland's ' Genetics of Cotton ' from the section on breeding and improvement is strange. A brief section on defoliation mentions only the use of calcium cyanamide and makes no reference to any of the literature on this important subject. The ' Control of Soil Water ' is an excellent and very readable account of methods used and results obtained in investigation on the behaviour of soil water, but there is little concerned with actual control. ' Soil Nitrogen ' is again misleadingly titled, being mainly a review of work on soil nitrogen levels, again virtually restricted to the U.S.A. The sections on bacterial transformations omit all reference to Lees' work on nitrification and to Jensen's important studies of the nitrogen economy of Australian wheat soils. There is only one brief reference to Rothamsted work. The reviews of reclamation of coal mine spoils and the presentation and storage of forage crops are very valuable.

This volume should be very useful to agronomists, but future numbers can be improved, particularly if it can be decided whether complete coverage of literature and concentration on the bibliography—or an authoritative readable discourse on the present state of knowledge is required.

J. L. HARPER.

Progress Report

On Field Experiments, 1945-1949. Pp. 27. Published by the Home Grown Threshed Peas Joint Committee, 1950. Obtainable free from the Committee, 4 Westgate, Peterborough.

The Home Grown Threshed Peas Joint Committee has published its first ' Progress Report on Field Experiments,' which summarises the trial work carried out during the five years 1945-49. The booklet has been produced mainly for the benefit of pea growers so as to acquaint them with the problems that are being investigated.

Since 1945 experiments on many subjects connected with the cultivation of threshed peas have been carried out by the Committee's technical staff, many of them in collaboration with the Rothamsted Experimental Station, the National Institute of Agricultural Botany and the National Agricultural Advisory Service. Over 150 trials and experiments were arranged during the five years, although, of course, not all of them have been completed, hence the title ' Progess Report.'

Field experiments have included fertiliser requirement trials, variety trials, seed disinfection tests, investigations into date and depth of sowing, spacing and seed rates, weed control, pest control and irrigation investigations. A selection of the findings from these experiments is given below:

Potassium proved to be the most important of the principal nutrients in nitrogen-phosphate-potash trials, although, on the whole, peas are relatively unresponsive to manuring.

In nine trials the large blue variety of Dutch origin, *Servo*, outyielded *Zelka*, a marrowfat or so-called *Harrison's Glory* variety. These results, however, represent the outcome of only one year's investigation and should be treated cautiously. From evidence obtained it appears that sowing should be done as reasonably early as possible.

A contact herbicide containing 27% ammonium salt of DNBP (2:4-dinitro-6-secondary butyl phenol) showed the most encouraging results as a weed control treatment from trials with five hormone weed killers. The most promising degree of control of the pea aphis was secured with HETP (hexaethyltetraphosphate) and HETP/DDT post-treatments (*i.e.* after an infestation of pea aphis has developed).

These are a few of the results, picked at random, which are in this booklet and in its 27 pages there is a considerable amount of information.

Rice

FAO Commodity Report on Rice (No. 2). Pp. 29. FAO Publication, 1951, 1s. 9d.

The present world rice position has been tabulated and set out in this, the latest FAO Commodity Report. It is a story of missed opportunities, lack of capital investment and rising populations. The Report states ' Rice consumption levels in the Far East remain seriously low as compared with pre-war; supplies available for consumption in the region in 1950 are about 3% below the pre-war average whereas the total population has apparently increased by 10% since 1937.'

Yields of paddy (rough rice) average only about 13 metric quintals in Asiatic countries (e.g. India 11.5 metric quintals, Burma 12.4 metric quintals, Pakistan 14.1 metric quintals) with the exception of Japan where they reach 38.8 metric quintals. This compares with 47.3 metric quintals in Australia, 44.8 metric quintals in Italy, 39.6 metric quintals in Egypt and 24.7 metric quintals in the United States.

The Report discusses the outlook for rice production. South-East Asia's export availability is likely to remain virtually static around 2½ million tons. Therefore the precarious balance between supply and demand that obtained in the Far East in 1950 could be upset by relatively small increases in the import demand of the food-deficit countries. This warning deserves attention the more since the Report was completed before the seriousness of the present food shortage in India became apparent.

The Oxford Farming Conference

THE fifth Oxford Farming Conference was held from January 8-10 after a lapse of 12 years. Nearly 300 attended, and before the Conference ended it was decided that it should become once more a regular annual event.

Achievements of mechanisation

Mechanisation was the main topic this year and papers were read on a wide variety of subjects appertaining to the mechanising of various farm operations, particularly forage and root harvesting. The Ministry of Agriculture's chief scientific officer, **Sir James Scott Watson,** delivered the opening address on ' Ten Years of Mechanisation, and the Future.' He stressed the importance of aiming for a high output per acre as well as a high output per man. He considered that there was much to be said for the reintroduction of fodder roots which have tended to decline latterly. A moderate crop of mangolds, he pointed out, yields nearly twice as much starch equivalent per acre as an average barley crop. Mechanised sugar beet harvesting had arrived and it did not appear that there would be much difficulty in using the same technique for mangolds, swedes and fodder beet, but the need for a complete potato harvester was still great. He advocated a revival of winter bullock feeding; muck was more valuable to the land than many people thought and the general reintroduction of winter yarding would utilise quantities of straw and sugar beet tops which were at present wasted.

He did not consider that the country was over-tractored, as there was much to be said in favour of a reserve of power which enables tillage operations to be performed under optimum conditions.

A feature of the last ten years was that full employment, together with pool labour, had led to a greater degree of under-employment at the slack seasons. Britain could not imitate the farming systems of Denmark, Holland and Belgium because she had not the concentration of labour that they had. Nor could she be content with the comparatively low yields of American farms despite their high output per man. Britain had her own particular problems to solve.

The changing years

Mr. J. O. Cherrington, a Hampshire farmer, described his experiences and difficulties since 1939, when about 900 of his 1,100 acres were permanent pasture. Today he had about 300 acres of permanent grass and leys, the rest arable. In 1940 he introduced a combine harvester and the following year a drier and storage. He had this to say about the introduction of machines: ' a machine must either be

J. O. Cherrington on the platform. Seated are Gordon Saunders and Roger North; the latter was Chairman of the Conference

(*Left*) **Sir James Scott Watson, head of the National Agricultural Advisory Service, spoke on mechanisation and the future.** (*Right*) **(Left to Right) Gordon Saunders, Clyde Higgs, D. Seligman and Rex Paterson**

capable of replacing labour by performing the same work at less cost in manpower, plus depreciation and maintenance, or else it must be the means of increasing the output of existing labour. If the machine does not fulfil either of these demands, it should not be bought.' In his appreciation of machines, Mr. Cherrington put the milking machine and tractor first, followed by the combine harvester with its ancillary drying and storage. He considered that in his case the only real innovations were not the mechanisation of existing processes but the use of selective weedkillers, coupled with the low-volume sprayer, and the buckrake.

Root harvesting

A symposium of papers on root harvesting was given by three farmers and a member of the National Institute of Agricultural Engineering. There seemed little doubt that mechanical harvesters saved costs and labour, and the addition of rear-elevators and self-emptying trailers further reduced them. One make of harvester can be used as a potato and carrot digger, a complete turnip harvester and a harvester of previously topped sugar beet, thus showing that its efficiency had not been sacrificed for the sake of versatility.

One Lincolnshire farmer said that he did not use a complete root harvester on his heavy land and, instead, split the harvest into two operations using three different machines. First comes the topping operation, using a top saver or Danish type single-row topper drawn by a horse; then a two-row Fordson lifter and cleaner is used for lifting, in conjunction with a side-delivery rake.

At the N.I.A.E. a Universal root harvester has been developed, based on the revolving drum mechanism. It harvests sugar beet, potatoes or turnips, and although not expected to do work of the same quality as specialised root harvesters, the machine is designed to carry out satisfactorily the heavy tasks involved in root harvesting.

A Shropshire farmer gave his views on potato harvesting for which, he considered, there was at present no satisfactory harvest machinery. The simplest method, the potato plough, wastes too much of the crop, while the spinner bruises the tubers. The elevator digger was favoured by the large grower but it had its limitations and was liable to break down frequently. His own harvester had a large saucer-shaped rotating primary sieve from which potatoes were passed to a second rotating sieve and then to a third for sorting. From there the crop passed up an elevator and into a trailer.

Harvesting green crops

Another symposium given at the Conference was on harvesting green crops. **Mr. Rex Paterson,** pioneer of the buckrake, described the silage-making methods employed on his Hampshire farms. With crops averaging about three tons per acre and situated within about 500 yards of the silage pit he has found that a team of two or three buckrakes, one mower and one man in the pit works very well. As each buckrake is independent of the others the system has extreme flexibility. One man cuts the crop, while the buckrakes pick it up (an average load weighs about 3 cwt.) and carry it to the pit where it is dumped exactly where it is wanted. One tractor may be used for consolidating the material in the pit. This method was found to use 5½ man-hours per acre and about 2 man-hours per ton.

Mr. Gordon Saunders described the method he uses to harvest cocksfoot for drying. By using an outfit that picks up, transports and empties about 25 cwt. of wet material, he has reduced his labour requirement considerably. Two self-emptying trailers were used so that while one is travelling about a mile to the drier the other is being filled behind the pick-up. Previously, with four tractors and at least six men, he needed two hours overtime per day to supply the drier with its daily requirement of 30 tons of green material. Now with two tractors and two men the 30 tons can be got to the drier in something like six hours.

Pre-drying grass

Mr. Saunders also told the Conference that experimental pre-drying of grass by blowing unheated air through wet material showed encouraging results. It appeared that at least two-thirds of the water to be got rid of can be evaporated in this way if the unheated air is blown through the grass for from 8 to 15 hours, depending on conditions. If this practice became universal the saving in fuel would be enormous.

Two other papers were given on this subject of green crop harvesting, one on the difficulties of the job and the other on the suitability of silage for the small farm.

After each paper there were discussions, although the Conference embraced so many different subjects that it was impossible to do them all justice in the limited time. This point was brought to the notice of the Conference by **Mr. Clyde Higgs,** and it may be that next year the Oxford Farming Conference will become a more specialised affair.

Photos: 'Farmer and Stockbreeder.'

FARM MACHINERY

Demonstrations of British agricultural machinery have been held in Jordan, organised by the British Overseas Engineering and Construction Corporation, Ltd. The photo above shows some of the spectators at a demonstration held near Amman, the capital

Paris Show

The Paris General Agricultural Show will be held again this year, for the first time since 1939, from February 27 to March 5. The site chosen for the show is the Parc des Expositions, Porte de Versailles, and the show will take place simultaneously with the Agricultural Machinery and Poultry Shows.

500-15 gal. Sprayers

The accompanying photographs show some of the spraying machines made by the Dorman Simplex Co. of Cambridge. The two latest machines to be developed by this company are the 100 gal. high and low volume crop sprayer and a larger machine of 500 gal. capacity. The former is designed for the farmer, having a 21-ft. spray boom, row crop axle, and capable of applying from 10 to 100 gal. per acre. The larger machine has been designed for the contractor. It also has a high and low volume sprayer fitted with a triple ram pump giving pressures of up to 300 lb./sq. in.; the spray gives cover of 35 ft.

Both these sprayers have been developed from the 250 gal. sprayer. Acid spraying is catered for by two standard models of 50 and 150 gal. capacity respectively.

For the market gardener the company is producing a 'wheelbarrow' sprayer on two or three pneumatic tyres and with a tank capacity of 15 gal. It can be fitted with a front-mounted spraybar or used with a nozzle and lance for low and high volume spraying.

Dried Grass Enquiry

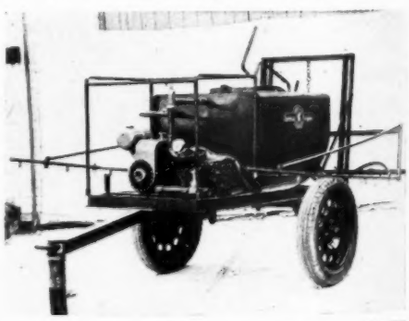
The Ministry of Agriculture and Fisheries is undertaking a special enquiry into statistics of the production and disposal of artificially dried grass and other forage crops during the year ended December 31, 1950. A question was included in the December 1950 quarterly return asking occupiers to state whether they had a grass-drying plant on their holding, and forms of enquiry will be sent to all occupiers who answered 'Yes' to that question.

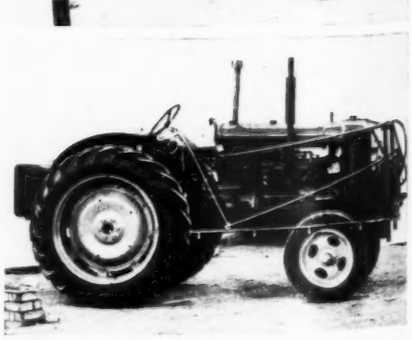
The enquiry is a voluntary one, but the Ministry hopes that all occupiers who receive the form will co-operate by completing it. The Ministry states that all information supplied will be treated as strictly confidential and in no circumstances will any individual return be disclosed without the written consent of the person making the return.

New Grain Storage Film

A film on the storage and handling of combine-harvested grain is being made by the Farm Service Department of Shell-Mex and B.P. Ltd. and is expected to be ready this summer. It will aim to show that it is far easier for a farmer to buy a grain drier than to estimate the effect of drying upon the quality and market price of his crop. He must understand the properties required in the grain by the miller, the maltster and other buyers, otherwise damage may be done, which hits both him and his customers.

During the last three years films produced by the company have included ones on paraffin- and diesel-tractor maintenance, rust prevention and grass drying.





(*Top left*) **A 500-gal. crop sprayer with 35-ft. spray bar, capable of pressures up to 300 lb./sq.in.** (*Bottom left*) **250-gal. high/low volume sprayer.** (*Top right*) **100-gal. sprayer, having a 21-ft. spray bar, rowcrop axle and mechanical agitator; applications of 10-75 gal./acre can be made.** (*Bottom right*) **50-gal. tractor-mounted low-volume sprayer with front-mounted spray boom and rear-mounted tank**

Manufacture of Harrow and Plough Discs

THE manufacture of agricultural implements such as sickles, bill-hooks and scythes has been carried out in Sheffield and its outlying districts for many centuries.

In conformity with modern trends in agriculture, considerable interest has been shown by Sheffield makers in the use of disc-type harrows and ploughs. These have been extensively used overseas for a number of years, and have played a considerable part in colonial development. In the U.K. the use of the disc harrow has gained in popularity during the past few years, but the disc plough has not made the same headway. At the present time about 80% of the discs made in Sheffield are for overseas markets, whether direct or via agricultural machinery manufacturers.

Harrow disc range

The harrow discs range from 16 to 24 in. diam. in five different sizes, varying from 10 gauge to $\frac{3}{16}$ in. in thickness, whilst the plough discs range from 24 to 36 in. diam. and vary from $\frac{3}{16}$ to $\frac{1}{2}$ in. in thickness. The steel used for these discs has a carbon content varying from 0.65 to 0.80%, according to the thickness of sheet required. These sheets are made to a close specification by local steel-makers, who roll them to the desired thickness for the disc-making firms. When received they are first sheared to squares of suitable dimensions; a hole is next punched in the centre of the prepared square and the plate is then cut to the appropriate disc diameter on a circular cutter.

The circular sheet is placed in a standard oven type gas-fired heat-treatment furnace and raised to a temperature of approximately 900°C. It is then withdrawn, placed between the dies of a hydraulic press for pressing to its final dished shape and quenched in an oil tank. As the temperature of the disc upon leaving the press is about 800°C., and the central portion is at a lower temperature than the edge, advantage is taken of these conditions to 'catch-harden' the edge of the disc during the above operations, so saving a reheating process. It is found, however, that whilst it is practicable to harden the large discs in this way, it is necessary to reheat the smaller ones owing to their lower thermal storage capacity.

The gas furnace

Whilst 'catch-hardening,' that is waiting until the edge of the plate has cooled to the correct temperature for hardening, has proved to be reasonably successful it has been felt by the makers that there should be available a more consistent and controllable method of dealing with this important heat process, and the Industrial Gas Development Committee was accordingly approached with a request to give consideration to a furnace unit for this purpose, covering a range of discs from 20 to 30 in. diam. They proposed a central table of $\frac{1}{2}$ in. thick mild steel plate suitably drilled to take an appropriate number of Fletcher Russell No. C.R. 20 type air-blast slot burners arranged in such a way that they produced a continuous vertical ring of flame in a circle 3 in. less in diameter than each size of disc, the flame-splash running about 1 in. backwards towards the centre as well as to the rim of the upturned discs, giving an evenly heated strip of metal $2\frac{1}{2}$ in. wide in each case. The maximum number of burners for this unit is 26, and two burners less are required for each smaller flame circle. Tests on a 24 in. diam. disc $\frac{3}{16}$ in. thick with an unbevelled edge showed that this could be heated to about 750°C. in six minutes on a gas consumption rate of 1,520 cu. ft. (7.6 therms) per hour or 152 cu. ft. (0.76 therms) per disc. With bevelled edges this could be reduced to five minutes at 127 cu. ft. (0.635 therms) per disc, so that a consumption of 140 cu. ft. (0.76 therms) can be considered as an average figure.

Removing a hot disc (temperature approx. 900°C.) from the furnace prior to pressing into a dished shape

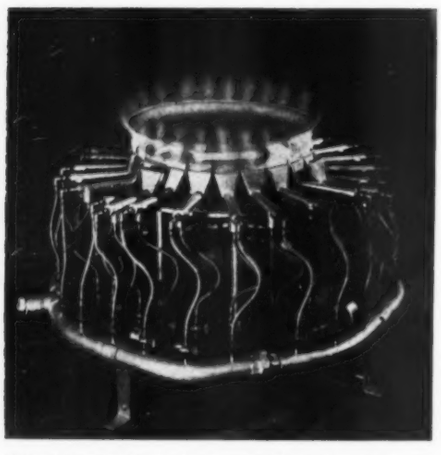
Hot disc about to be dished. The man on the extreme right is about to lower a shaped disc into an oil-quench tank

Cutting steel plate to the appropriate disc diameter on a circular cutter

The first tests were made with discs packed up from the mild steel table, but owing to warping tendencies due to radiated heat from the flames and discs it was decided to have a 3-in. hole made in the centre of the plate and to have a protective cover placed over this, lined with 1½ in. of Gibbons H.T.I. brick with a ¾ in. air space between the cover and the plate. This proved entirely satisfactory.

Cooling

After hardening, the discs are loaded into a batch-type gas-fired forced-air recirculation tempering oven at a temperature of about 360°C., left to soak, and then allowed to cool slowly. The periphery of the hardened and tempered disc is then retouched on the grinding machine, the harrow disc being finished and ready for painting. The plough disc, however, is bright-ground on the concave surface, which is then protected with a coat of clear rust-preventing varnish.



Gas-fired furnace in action heating a 24-in. disc

Photos: Industrial Gas Development Committee.

Promising Source of Pectin

Research at the Stellenbosch Fruit Research Station has shown that the fruit of the Mexican hawthorn (*Crateagus pubescens*) has a high pectin content, according to an account in *Farming in South Africa*, and as the canned product has good qualities the fruit may in future be considered suitable for human consumption.

Originally imported from Mexico by the Department of Forestry 44 years ago, two trees now stand about 40 ft. high and yield two tons of fruit per season. The fruit is about the size of an apple and tastes rather like a cross between apple and quince. Approximately 70 lb. of pectin are obtainable from one ton of this fruit, whereas citrus fruits yield only about 32 lb. per ton.

South Africa imports pectin to the value of around £20,000 annually for its fruit and vegetable canning industry alone. Thus 'skaapvrug,' as the fruit is commonly known, may be considered as a source of raw material if the manufacture of pectin is to be undertaken on a commercial scale in South Africa.

Linseed Control Ended

As from January 28 the Home Grown Linseed (Control) Order (1948) has been revoked and growers in the United Kingdom may now sell their linseed to whom they please.

Linseed oil can now be readily obtained from soft currency areas overseas and it is no longer necessary to call on home farmers to make special efforts to grow the crop, which many have found difficult to grow and harvest. The peak year for linseed in this country was 1948 when nearly 86,000 acres were grown.

Until June 30, 1951, the Ministry of Food will continue to buy on the present basis of £55 per ton for seed of 90% purity linseed of the 1950 or earlier crops offered to it.

Feeding stuff coupons will still be issued in the ratio of 12 cwt. of linseed cake to each ton of clean linseed, from the crops mentioned.

Turkey Buys British

Delivery of 1,150 Fordson 'Major' tractors, valued at £620,000, from the United Kingdom to Turkey, has now begun. The majority of these tractors are to be utilised under a Turkish Ministry of Agriculture scheme for the reclamation of land in the Urfa district of South-East Turkey.

Trace Elements and Fruit Trees

In November last an Open Day was held at East Malling Research Station at which a series of talks was delivered, dealing with the problems of mineral deficiencies in the nutrition of fruit trees.

In the course of the talks various aspects of the problem were discussed and demonstrations given of the laboratory and field techniques involved in the diagnosis and treatment of different types of mineral deficiency, notably those attributable to the so-called trace elements.

At the close of the meeting the practical points that are emerging from this work were summed up by Major S. G. Ferguson. In the course of his remarks he pointed out that it is better to avoid trace element deficiencies than to try to cure them, therefore particular attention should be paid to the soil and its management.

He stressed four points: (1) The physical conditions of the soil must be right. (2) The more organic matter (humus) in the soil the less is the liability to trouble, though deficiency of manganese, zinc and copper might be exceptions to this. In this connection grassing-down, cover-cropping, etc., are obviously important. (3) The more lime in the soil the greater is the liability to trouble. Very little is known as to just how much lime fruit plants require, in spite of the tradition that stone fruits like lime. Fruit can be grown over a wide range of pH though it seems best to aim at having the soil a little on the acid side of neutrality. (4) A balance of nutrients is important. This is fairly easy with the major elements but difficult with the trace elements.

Major Thompson admitted that troubles sometimes arose even when a grower has done his best on all these points, and stated that deficiencies of magnesium, manganese and iron are those most likely to occur. Zinc and copper deficiency had been turning up recently, and it is hard to see why boron deficiency has not also occurred.

It is easy to cure manganese, zinc and copper by suitable sprays but iron is more difficult. With trees, solid injections are effective and the choice of tolerant varieties or rootstocks may supply a lasting solution, but nothing can yet be suggested for soft fruits. Magnesium also provides a problem, because the four or five sprays per annum needed to obtain a cure are an unwelcome addition to the spray programme. It is therefore important to spot the trouble in its early stages and then consult the Advisory Service on how best to deal with it.

WORLD CROP REPORTS

SOUTHERN RHODESIA

Turkish tobacco. New hopes for the growing of Turkish tobacco were expressed at the annual meeting of the Turkish Tobacco Co-operative Co. of Rhodesia Ltd. It was stated that Rhodesian Turkish had a high reputation and would have an assured demand for years ahead. The colony's crop for the last two years has been around 333,000 lb. each season, which is not more than a tenth of what used to be regarded as a good crop, due mainly to the increased cultivation of Virginian.

Tobacco restriction scheme. The Rhodesian Tobacco Association has been asked by the Minister of Agriculture, Mr. P. B. Fletcher, to submit a scheme under which the Government could, in the event of a national emergency, restrict the expansion of the tobacco industry or even stop it. The Minister told the Council he thought the pegging of tobacco production might be necessary next year and the stage had been reached when the Government was obliged to plan for any eventuality.

Answering questions, Mr. Fletcher said: 'As yet, no decision has been taken on whether the position is serious enough to stop new growers coming in and pin down the industry to this year's production. It looks to me as if we shall have to do that. I think next season, in the light of shortages occasioned by the rearmament programme, we will have to try to stabilise at this year's figure. The Government is now going into the question of emergency legislation.'

INDIA

Punjab irrigated cotton. 400,000 acres of irrigated land were brought under cotton cultivation last year, as against 248,000 acres the year before. Steps are also being taken to introduce varieties promising better yields.

Cotton makes good progress. Preliminary estimate of the Indian cotton industry puts 1950-51 production at 3,581 million bales, which is about 25% over the 1949-50 production of 2,885 million bales.

Increased production is expected of most of the principal varieties, estimated increases being 470,000 bales of medium- and short-staple varieties, 100,000 bales of long-staple varieties and about 120,000 bales of unspinnable varieties. The latter are generally used for mattresses, cushions, etc.

Raw jute production. Production of raw jute in 1950-51 was estimated at approximately 4,500,000 bales, nearly 1,000,000 bales short of the 5,400,000 bales required by Indian mills annually. However, during the last three years production has risen considerably from 1,700,000 in 1947-48 to 2,100,000 the following year and to 3,000,000 bales in 1949-50.

SWITZERLAND

Agricultural production, 1950. Gross proceeds of Swiss farm production in 1950 (excluding the value of products used by farmers themselves, e.g. feed grains, hay, straw, hatching eggs, etc., not sold) is provisionally estimated by the Swiss Farming Secretariat at 2,242.3 million francs. This compares with 2,228.3 million in 1949, with the increase due entirely to an advance of 19.3 million francs in vegetable cultivation. Output of animal products, on the other hand, was down by 5.3 million francs. Animals and animal products accounted for 73.8% of the total gross proceeds last year, compared with 75.9% in 1935-39.

All branches of plant cultivation showed increases in the gross value, except for grains and vegetables. The following table illustrates the changes in the various branches of crop production:

	Gross Value of Production in millions of Francs	
	1949 (*final*)	1950 (*provisional*)
Grain	156.2	136.4
Potatoes	75.2	81.4
Sugar beet	13.9	14.4
Tobacco	7.5	8.0
Hay, for non-agricultural horse stables	5.4	3.4
Grapes for wine	62.2	77.4
Fruit	114.1	137.0
Vegetables	130.0	126.0
Other plants (esp. oil and fibre plants)	3.8	3.6
Total crop cultivation	568.3	587.6

LEBANON

Low olive oil crop. Lebanon's olive oil production is expected to be only 10% of the 1949-50 volume of 11,000 short tons (7,700 edible), according to the American Legation, Beirut. Heavy spring rains which destroyed the flowers and blossom buds of the olive trees, particularly in the coastal regions, account for the sharp decrease.

GERMANY

Expansion of beet area. A further extension of the West German area under sugar beet is planned in the next few years. A 10% increase is expected in 1951-52.

Increased sugar beet cultivation would require an enlarged processing capacity of German sugar mills. The present processing capacity of the 71 West German sugar mills for a 90-day processing period is 1,000,000 tons less than this year's estimated crop of beets. It is planned to construct four or five new big sugar mills.

ITALY

Wheat for Italy. Economic Cooperation Administration (ECA) has approved the spending of 500,000 dollars in Marshall Plan funds for wheat for Italy. It is to be purchased before March this year and shipped not later than May.

EGYPT

Crop estimates for 1952-53. As the Egyptian population is growing at a high rate and is estimated to reach 21,189,000 by 1953, the present cultivated area of 5,822,000 acres is felt to be too small to support the population. The Egyptian Government is taking steps to increase crop production during the next two years and below is a list of some of the crop targets for 1952-53. The table is from a report on the estimated production of various crops in the 1952-53 season, produced by the Director-General of the Department of Agricultural Economy and Legislation of the Ministry of Agriculture.

CROP ESTIMATES FOR 1952-53

Crop	*Area* (1,000 *hectares*)	*Production* (1,000 *metric tons*)
Wheat	588	1,260
Barley	63	135
Maize	609	1,421
Millet	185	570
Rice	281	1,108
Potatoes	20	282
Sugar cane	40	2,986
Horse beans	165	305
Lentils	34	58
Fenugreek	22	31
Groundnuts	11	19
Sesame	17	12
Cotton	819	852
Onions	17	280
Water melon and musk melon, sweet melon	18	320
Citrus	15	227

Note: 1 hectare = approximately 2.4 feddans or 2.5 acres.

These figures were supplied by the Agricultural Attaché at the Royal Egyptian Embassy in London, and appeared in the latest issue of the Journal of the Anglo-Egyptian Chamber of Commerce (December 1950).

HOLLAND

1949-50 production. According to the Dutch Central Bureau of Statistics, the total agricultural and horticultural production of the Netherlands during the 1949-50 season was valued at about 3,000 million guilders (approx. £275 millions; one guilder = 1s. 10d.). Of this figure, 670 million guilders were derived from field crop production, 520 millions from horticulture and 1,880 millions from livestock and dairy products.

In the table below, the crop figures are split up in detail and may be compared with the equivalent figures for the years 1938-39, 1947-48 and 1948-49; the figures represent production in millions of guilders.

	1938/39	1947/48	1948/49	1949/50
Field crops :				
Cereals ..	72	116	114	188
Legumes ..	12	10	10	23
Potatoes ..	42	233	189	266
Other roots ..	16	60	67	98
Other farm crops ..	11	31	61	90
Hay ..	2	3	3	5
Total ..	155	453	444	670
Horticultural crops :				
Vegetables ..	40	151	178	189
Onions ..	7	13	14	18
Early potatoes	6	24	22	17
Fruit ..	25	133	159	145
Flower bulbs	20	47	45	53
Cut flowers ..	16	57	54	60
Trees ..	4	10	11	13
Seeds ...	2	17	20	25
Total ..	120	452	503	520

BRAZIL

Bahia cocoa estimates. The 1950-51 Bahian cocoa crop is expected to reach at least 2,300,000 bags of 60 kg. This is about 600,000 bags more than the original Bahia Cocoa Trade Commission's estimate, although 200,000 bags less than last year's record crop.

1951-52 coffee. An unofficial but reliable source, according to *Foreign Crops and Markets*, tentatively forcast the coffee available for transport to ports from Brazil's 1951-52 crop at about 17.3 million bags. The crop is harvested from May to September this year and marketed from July right through to June next year.

About 1.2 million bags are expected to be consumed in Brazil, leaving about 16.1 million bags for export. This compares with the revised exportable production estimates of 14.1 million bags from the 1950-51 crop and 15 million from the 1949-50 crop. The annual average pre-war (1935-36 to 1939-40) exportable production was 21.7 million bags.

GREECE

Less olive oil. Greece's 1950-51 olive oil production is placed at approximately 60,000 short tons, according to an official preliminary estimate. This represents the second lowest volume in 20 years (1948 production was 50,000 tons) and less than a quarter of last season's output, recently revised to 247,600, the largest in the history of production records in Greece going back to 1921.

The sharp drop in 1950 production is attributed to: (1) weather conditions, notably extreme drought during the spring and summer months and strong, dry, hot winds of July and August, which caused premature drop of olives; (2) the extremely heavy bearing of last year, which caused a sharper alternate year yield decline than usual; and (3) severe attacks by the Dacus fly in some areas.

The Greek Ministry of Agriculture states that planting of olive trees has increased steadily in all producing areas since liberation because of (1) the desire of farm families to become self-sufficient in fats, (2) privations experienced by the lack of oil during the German and Italian occupations, and (3) high price of olive oil in comparison with other agricultural products.

Harvesting and pressing of olives were expected to be completed by the end of December. Despite Dacus fly attacks, this year's crop is expected to be of good quality and the quality of the processed oil probably will be improved by more widespread use of modern olive oil crushing plants and the installation of modern separators in old plants.

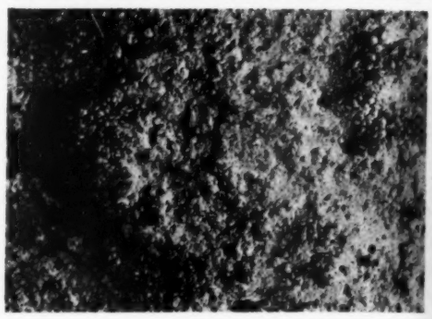
Annual consumption of edible olive oil is estimated at 105,000 to 110,000 tons. Stocks at the end of the crop year—October 31, 1950—are indicated at about 140,000 tons.

CUBA

Less tobacco foreseen. Cuba's 1950-51 tobacco crop has been preliminarily forecast at approximately 25% below the 1949-50 record harvest. Leaf exports during the first eight months in 1950 were reportedly 4% below the same period in 1949 and cigar exports were 33% lower than the comparable 1949 period.

The country's 1950-51 leaf crop is unofficially forecast at approximately 69.4 million lb., as compared to the preliminary estimate of 97 million lb. in 1949-50 and 53.3 million lb. in 1948-49. Cuba is expected to produce about 66 million lb. of sun-grown leaf and 3.4 million lb. of shade-grown leaf in 1950-51.

Raindrop Erosion



An editorial comment on page 87 of this issue discusses briefly the effect of raindrop erosion. The subject has been studied under laboratory conditions at, among other places, the Hydrological Laboratory of the Ohio Soil Conservation Service, where the action of water applications at measured rates, in form simulating rainfall, on the surface of various types of soil has been recorded.

The photographs show the effect on the surface of a medium soil of one hour of application of simulated rainfall falling with about one third the velocity of natural rain. It will be seen how the crumb structure has been completely broken down as a result of the impact of the raindrops. The cracks in the soil which normally allow water to penetrate become sealed off by the broken down material and the absorptive capacity of the soil is greatly lessened, while the water flowing over the surface increases sheet erosion.

WORLD CROPS

OUR NEXT ISSUE will include an article dealing with the critical position of **jute and the jute industry** as a result of the partition of India, an account of the developments of **cotton growing in Hungary** since 1945, a description of recent **progress in soil bacteriology** by Dr. F. Gibson, Chief Bacteriologist of the Edinburgh and East of Scotland College of Agriculture, and an article on the **manuring of rice,** summarising present practices, in addition to other articles and regular features.